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VOL. CXXXVI.—No. 3528] LONDON: FRIDAY EVENING, AUGUST 10, 1923 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

G. R.

LAKEDOWN AERODROME.

Tenders are Invited for the PURCHASE and REMOVAL of HANGARS at the above Aerodrome.

The buildings consist of brick, wood, with corrugated galvanised iron and corrugated asbestos, doors, windows, &c. &c., together with all fittings.

All materials will be required to be removed and the sites reinstated to the satisfaction of the Roads and Communications Officer within 12 months from date of acceptance of contract.

Tender forms and full particulars with permission to view can be obtained from ROADS and COMMUNICATIONS OFFICER, Salisbury.

Tenders should be endorsed "Lakedown" and delivered to

Roads and Communications Office,
Evelyn House, Salisbury,

not later than Twelve Noon, 28th August, 1923. 3218

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES :—

1. AXLES for RAILWAY CARRIAGES and WAGONS.
2. DUPLICATE PARTS of LOCOMOTIVES.
3. SPRINGS, HELICAL and VOLUTE.
4. SPRINGS, LAMINATED.
5. BUFFERS, DRAW-BAR CRADLES and HOOK ENDS, &c.

Tenders due on the 4th September, 1923.
Tender forms obtainable from above. 3223

Sale of Pumping Machinery at HELL WATH PUMPING STATION, SOUTH CAMP, RIPON, YORKSHIRE, by PRIVATE TENDER.

This machinery consists of :—

2 National Oil Engines, Nos. 1990 and 1991, horizontal oil engines, water cooled, T.O. type, 25 H.P., 280 revs. per minute, complete with driving pulleys, 40in. by 14in., and blow lamp and spares.

2 Rees Roturbo Pumps, Nos. 4160 and 4161, turbines on centrifugal system, belt driven from engine pulley, head 110ft., revs. 1250, gallons per hour 20,000, complete with bed-plate pedestals, fast and loose pulleys and striking gear.

6 Cooling Tanks, approx. 400 gallons each.
2 Oil Tanks, approx. 400 gallons each.
1 Water Gauge, reading to 60 lb. per sq. in., also feet head to 140 lb. per sq. in.
45 Feet Steam Pipe, 4in. diameter.
2 Sluice Valves, 6in.
2 Guards (Wire), 8ft. by 4ft. and 10ft. by 4ft.
2 Priming Cocks, 1in.
32 Feet Chequered W.I. Plates, 15in. wide.
23 Feet Chequered W.I. Plates, 18in. wide.
1 No. 4 Rotary Hand Pump.
1 Receiver fitted with gauge and safety valve for self-starting.
1 Compressor fitted with fast and loose pulley.
36 Feet Steam Pipe, 2in.

The plant can be inspected on site by prior arrangement with Roads and Communications Officer, R.E. Office, North Camp, Ripon.

Tenders, in envelopes endorsed in left-hand top corner "Tenders for Machinery at Ripon," should be addressed to the COMMANDING ROYAL ENGINEER, 13, Wenlock-terrace, York, and should reach that office by Twelve Noon on Monday, 3rd September. 3191

The Air Ministry Invites TENDERS for the PURCHASE of the following MACHINERY :—

ONE 70 H.P. HORIZ. OIL ENGINE, by Fielding and Platt, with necessary piping, cooling tanks, oil tanks, filters, belting, &c.; the whole in working order.

ONE GENERATOR, D.C., shunt wound, by Phœnix Dynamo Co., 850 r.p.m., 152 amps., 230 volts, enclosed type, mounted on C.I. bed-plate, belt driven; in working order.

ONE GENERATING SET, 7 K.W.; Petrol Paraffin Engine, by Auter Eng. Co., 2 cyl., direct coupled to Compound Wound Generator, 1050 r.p.m., 43 amps., 230 volts, by Electric Construction Co., Wolverhampton, the whole mounted on C.I. bed-plate and in working order.

The above lying at Lympne Aerodrome, Westenhanger Station (S. Rly.).

TWO 50 H.P. SEMI-DIESEL OIL ENGINES, by Robey and Co., 250 r.p.m., with necessary cooling tanks, oil tanks, piping, &c. Cylinder heads damaged, otherwise in good condition.

TWO DYNAMOS, 30 K.W., D.C., by Holmes Generator Co., 860 r.p.m., 230 volts, 4-pole 4 interpole shunt regulator; in working order.

ONE SWITCHBOARD of 3 slate panels, 4ft. 3in. by 1ft. 3in. by 1½in., with insts. and fuses; in order.

The above lying at Hawkinge Aerodrome, near Folkestone.

Forms of Tender and authority to view may be obtained from the Clerk of Works, Works and Buildings Dept., Hawkinge Aerodrome.

Sealed Tenders must be delivered to the DIRECTOR of CONTRACTS (Contracts Tender Board), Air Ministry, Adastral House, W.C. 2, not later than 10 a.m. on 16th August, 1923.

The Air Ministry do not bind themselves to accept the highest or any Tender. 3257

Department of Scientific AND INDUSTRIAL RESEARCH.

An ASSISTANT CHIEF ENGINEER will be APPOINTED shortly to undertake investigations under the direction of the Bridge Stress Committee of the Department. The appointment will be for not longer than two years. Salary approximately £600 per annum. Preference will be given to engineers of railway experience and, other things being equal, to ex-Service candidates.

Application, stating age, qualifications, military service, &c., with copies of testimonials and/or names of referees, should be addressed to the SECRETARY of the DEPARTMENT, 16, Old Queen-street, S.W. 1, before August 31st next. 3263

Ministry of Transport. ROADS DEPARTMENT.

APPLICATIONS are INVITED for an APPOINTMENT as a TEMPORARY ENGINEER at a salary of £500 per annum inclusive, for Renewal Work to the Menai Bridge, North Wales. Candidates must be qualified in bridge construction work with practical experience and a knowledge of the structural design of bridges. The engagement will be on the bridge and will probably be for a period of about 18 months. Preference will be given to men who have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1. Applications can only be received on the recognised forms and should reach the Ministry on or before the 18th August, 1923. 3204

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Hydro-Electric Power Station for the City of York.

The Otira Tunnel, New Zealand.

The Effects of a Flood on an Irrigation System.

French Locomotive Performance—No. II.

The Economic Use of Wood.

Electricity in Coal Mines—No. III.

Recent Continental Diesel Engines.

A Novel Works Locomotive.

PUBLIC NOTICES

In the High Court of Justice, Chancery Division, Mr. Justice Romer. 1923, E. 071.

In the Matter of The EAST COAST STEEL CORPORATION Limited and Reduced; and

In the Matter of the COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that a PETITION has been presented to the High Court of Justice Chancery Division for CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £5,000,000 to £4,322,816.

By an Affidavit of Henry Hodgson the Secretary of the said Company filed in this matter on the 12th July, 1923, it appears that to the best of his knowledge information and belief there was not on the 10th July 1923 (the day fixed by the Order in this matter dated the 24th July 1923) any debt claim or liability which if such date were the commencement of the Winding-up of the said Company would be admissible to proof against the said Company.

Any person who claims to have been on the said 10th July 1923 and still to be a creditor of the said Company must on or before the 1st October 1923 send his name and address and the particulars of his claim and the name and address of his Solicitor (if any) to the undersigned at the address mentioned below or in default thereof he will be precluded from objecting to the proposed reduction of capital.

Dated this 31st day of July 1923.

JOHNSON WEATHERALL STUET and HARDY, of 7, King's Bench Walk, Temple, London, E.C. 4.
3206 Solicitors for the said Company.

In the High Court of Justice, Chancery Division, Mr. Justice Russell. 1923, K 041.

In the Matter of KITSON and CO. Limited and Reduced and

In the Matter of The COMPANIES (CONSOLIDATION) ACT, 1908.

Notice is Hereby Given that the Order of the High Court of Justice Chancery Division dated the 24th July 1923 CONFIRMING the REDUCTION of the CAPITAL of the above-named Company from £400,000 to £335,000 and the minute approved by the Court showing with respect to the share capital of the Company as altered the several particulars required by the above Act, were REGISTERED by the Registrar of Companies on the 7th day of August 1923. The said Minute is in the words and figures following :—

The capital of Kitson and Company Limited and Reduced is henceforth £335,000 divided into 335,000 shares of £1 each instead of £400,000 divided into 400,000 shares of £1 each. At the time of the registration of this Minute 235,000 shares of £1 each numbered 65,001 to 300,000 inclusive have been issued and the sum of £1 has been and is deemed to be paid up on each such share. The remaining 100,000 shares of £1 each numbered 300,001 to 400,000 inclusive have not been issued and nothing has been or is to be deemed to be paid up thereon.

Dated this 8th day of August, 1923.

VINCENT and VINCENT, 20, Budge-row, London, E.C. 4,
Agents for NORTH and SONS, 4, East Parade, Leeds,
3267 Solicitors for the said Company.

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 24th August, TENDERS for the SUPPLY of : PICKS, PHOWRAHS and SHOVELS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG, Secretary.

Offices : 91, Petty France, Westminster, S.W. 1,
8th August, 1923. 3265

PUBLIC NOTICES

Manchester Corporation Waterworks. HYDRAULIC POWER SUPPLY.

The Waterworks Committee invite TENDERS for ONE SET of ELECTRICALLY DRIVEN HIGH-PRESSURE CENTRIFUGAL PUMPS, to deliver 1000 g.p.m. against a pressure of 1120 lb. per square inch.

Specification and form of Tender may be obtained on application to the Secretary, Waterworks Offices, Town Hall, Manchester, on payment of Two Guineas per copy, which sum will be returned on receipt of a bona fide Tender. Any other information respecting the work may be obtained from the Water Engineer, Town Hall, Manchester.

Tenders must be delivered not later than the 15th September, 1923.

By Order, P. M. HEATH, Town Clerk.

Town Hall, Manchester,
7th August, 1923. 3248

Nottingham Corporation. NORTH WILFORD POWER STATION.

The Nottingham Corporation invite TENDERS for the MANUFACTURE, DELIVERY, and ERECTION of the undermentioned ENGINEERING WORKS in connection with the above Power Station, viz.:—

SECTION I.—STEAM, WATER and other PIPE WORK, VALVES, TANKS, &c. &c.

Specifications and forms of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W. 1, on payment of a deposit of £5, which will be refunded on receipt of a bona fide Tender within the prescribed time.

Extra copies of the specifications may be obtained on payment of Ten Shillings for each copy, which will not be returnable.

Sealed Tenders, endorsed "North Wilford Power Station, Tender for Pipe Work, &c.," must be delivered to me at my office not later than 10 a.m. on Friday, the 14th September, 1923.

The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is incomplete or which does not include the whole of the work covered by the specification.

W. J. BOARD, Town Clerk.

Guildhall, Nottingham,
10th August, 1923. 3265

Romford Rural District Council. RIVERSIDE SEWERAGE.

COMPLETION OF RAINHAM SECTION.

The above Council are prepared to receive TENDERS for the CONSTRUCTION of 24in., 21in., and 18in. Diameter PIPE SEWERS, including RIVER CROSSING, RAILWAY CROSSING, MANHOLES, FLUSHING TANK, and other incidental Works necessary to complete this section, in the Parishes of Rainham and Hornchurch, Essex.

Drawings, specification and quantities can be Inspected at the office of Mr. William Fairley, Consulting Engineer, Parliament Mansions, Victoria-street, Westminster, S.W. 1; also at the office of Mr. W. J. Grant, Surveyor to the Council, 16a, South-street, Romford, from whom a copy of the bill of quantities, inventory of plant and materials on the site, and form of Tender may be obtained on deposit of a crossed cheque for £3 3s., made payable to the Council, which deposit will be returned on receipt of a bona fide Tender.

Sealed Tenders must be delivered to the undersigned on or before Monday, the 3rd September, 1923.

The Council do not bind themselves to accept the lowest or any Tender.

T. W. A. GREENHALGH, Clerk to the Council.

16a, South-street, Romford, Essex.
7th August, 1923. 3266

PUBLIC NOTICES

University of Birmingham. FACULTY OF SCIENCE.

ENGINEERING DEPARTMENTS.

I. MECHANICAL ENGINEERING.

CHANCE PROFESSOR : F. W. BURSTALL, M.Sc., M.A. (Cantab.), M. Inst. C.E., M. Inst. M.E.
LECTURERS : R. C. PORTER, M.Sc. (Vict.), A.M. Inst. C.E.
DEMONSTRATOR : S. J. ELLIS, B.Sc., A.M.I.C.E.
LECTURER ON MACHINE DESIGN : F. H. BODEN, B.Sc.
ASSISTANT LECTURER ON MACHINE DESIGN : HENRY BAKER, B.Sc.

II. CIVIL ENGINEERING.

BEALE PROFESSOR : FREDERICK C. LEA, M.Sc., D.Sc. (Lond.), A.M.I.C.E., A.R.C.S.
LECTURERS : R. C. PANTON, M.Sc.
H. W. COULTAS, M.Sc.
T. H. P. VEAL, B.Sc.
LECTURER ON TOWN PLANNING : W. HAYWOOD.

III. ELECTRICAL ENGINEERING.

PROFESSOR : WILLIAM CRAMP, D.Sc.
LECTURER : E. J. KIPPS, M.Sc., M. Inst. E.E.
ASSISTANT LECTURERS AND DEMONSTRATORS : O. R. RANDALL, M.Sc.
H. VICKERS, Ph.D., M.Eng.
G. M. HARVEY, B.Eng.

THE FULL COURSES EXTEND OVER FOUR YEARS, and Students who enter after Matriculation and pass successfully the Examinations at the end of each year will BE ENTITLED to the DEGREE of BACHELOR of SCIENCE in Engineering.

The SESSION 1923-24 COMMENCES on OCTOBER 1st, 1923.

For detailed syllabus of the Faculty, with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 3226

University of London : University College. SESSION 1923-24.

FACULTY OF ENGINEERING.

DEAN : E. G. COKER, M.A., D.Sc., F.R.S., M. Inst. C.E., Professor of Civil and Mechanical Engineering.

THE SESSION BEGINS ON MONDAY, OCTOBER 1st.

DEGREE AND DIPLOMA COURSES.

Students desirous of entering the Faculty of Engineering with a view to taking a full Degree or Diploma Course must have passed the Matriculation Examination or some other examination accepted in its stead.

SPECIAL COURSES.

Students who have already undergone a partial training elsewhere and who have attained a sufficient standard, may enter for a Course occupying less than three years and may obtain a General Certificate of Engineering after not less than two consecutive sessions' attendance.

POST GRADUATE WORK AND RESEARCH.

Graduates in Science or Engineering, or students who have done the work equivalent to a Degree, may be admitted to Special Courses of Study or to prosecute original research.

ENTRANCE SCHOLARSHIP.

A GOLDSMID ENTRANCE SCHOLARSHIP, tenable in the Faculty of Engineering, value £90, will be competed for in September next. Application must be made not later than SEPTEMBER 8th.

ADMISSION.

Intending Students should communicate with the Provost forthwith and send a full statement of their previous training.

EXTENSION OF BUILDINGS.

Under the scheme of development begun four years ago, about £50,000 has been expended in buildings and equipment to increase existing facilities for training in the principles of science which form the foundation of sound engineering practice, and work is still in progress.

The new buildings, including the Charles Hawksley Hydraulic Laboratory, a Machine Tools Workshop, and a new Laboratory for Experimental Work, are now in full use.

Particulars may be obtained on application to the undersigned.

WALTER W. SETON, Secretary.

University College, London
(Gower-street, W.C. 1). 3237

Croydon Education Committee.

REQUIRED for the Central Polytechnic, a TEACHER of PRACTICAL MATHEMATICS and DRAWING to Apprentice Students (Mechanical) for one evening (Tuesday) per week. Fee 18s. per evening of two hours.

Applications, with particulars of qualifications, to be sent to the Principal, Central Polytechnic, Croydon.

J. SMYTH, Clerk to the Committee.
3236

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PUBLIC NOTICES

Norwich Corporation.

THORPE POWER STATION.

The Norwich Corporation invite TENDERS for the MANUFACTURE, DELIVERY and ERECTION of the undermentioned ENGINEERING WORKS in connection with the above-mentioned Power Station, viz.:

(a) TWO 5000-Kilowatt Three-phase TURBO ALTERNATORS of the Impulse Type, with EXCITERS, CONDENSERS, AUXILIARY PLANT, &c.
(b) THREE 40,000 lb. per hour WATER-TUBE BOILERS, with SUPERHEATERS, MECHANICAL STOKERS, FORCED DRAUGHT FANS, &c.
(c) ONE Motor-driven PAIR of 12-Kilowatt BOOSTERS.
(d) ONE 550 Ampere-hour BATTERY of ACCUMULATORS, with STANDS, CONNECTIONS, &c.
(e) ONE 50-Ton OVERHEAD TRAVELLING ELECTRIC CRANE.

Specifications, drawings and forms of Tender may be obtained from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, on payment of a deposit of £5 for each section, which will be refunded on receipt of a bona fide Tender within the prescribed time.

Extra copies of the specifications may be obtained on payment of Ten Shillings for each copy, which will not be returnable.

Sealed Tenders, endorsed "Thorpe Power Station, Tender for ——," must be delivered to me at my office not later than 10 a.m. on Tuesday, the 11th September, 1923.

The lowest or any Tender will not necessarily be accepted, and the Corporation will not consider any Tender which is incomplete or which does not include the whole of the work covered by the specification for any section.

ARNOLD H. MILLER,
Town Clerk.

Guildhall, Norwich,
August, 1923. 3246

Singapore Municipality.

The Municipal Commissioners of the town of Singapore invite TENDERS for the SUPPLY, DELIVERY and ERECTION in Singapore of the following PLANT :—

SECTION A. — 5000-Kilowatt TURBO-ALTERNATORS and CONDENSING PLANTS.
SECTION B. — WATER-TUBE BOILERS, DRAUGHT PLANTS and STEEL CHIMNEYS.

Specifications for both sections may be obtained on and after August 13th from Messrs. Preece, Cardew and Rider, 8, Queen Anne's-gate, Westminster, S.W.1, on payment of a deposit of £2 for each section (issued in duplicate), which will be refunded on receipt of a bona fide Tender. Extra copies may be purchased on payment of 10s. per specification.

Sealed Tenders, in duplicate, endorsed "Singapore, Section A" or "Section B," are to be delivered to the Agents of the Singapore Municipality, Messrs. C. C. LINDSAY and PEIRCE, 180, Hope-street, Glasgow, on or before Noon on Friday, September 7th.

The Municipal Commissioners do not undertake to accept the lowest or any Tender. 3243

The Great Indian Peninsula

RAILWAY COMPANY.

The Directors are prepared to receive TENDERS for the SUPPLY of the following STORES, namely :—

No.		Fee for Specification.
1.	HELICAL SPRINGS and VOLUTE SPRINGS	10s.
2.	STEEL FISH BOLTS	10s.
3.	SPARE PARTS of CARRIAGES and WAGONS (W.I. Axle Guards, &c.)	10s.
4.	STEEL TYRES for CARRIAGES and WAGONS	10s.
5.	SPARE PARTS of CARRIAGES and WAGONS (Buffers, &c. (I.))	10s.
6.	STEEL RAILS and FISH-PLATES	£1
7.	GIBS and COTTERS	5s.

Specifications and forms of Tender may be obtained at this office on payment of the fee for the specification, which payment will not be returned.

The fee should accompany any application by post. Cheques and postal orders should be crossed and made payable to the Great Indian Peninsula Railway Company.

Tenders must be delivered in separate envelopes, sealed and addressed to the undersigned, marked "Tender for Helical Springs and Volute Springs," or as the case may be, not later than Eleven o'clock a.m. on Tuesday, the 21st August, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

R. H. WALPOLE,
Secretary.

Company's Offices :
48, Copthall-avenue, E.C. 2,
London, 8th August, 1923. 3264

The South Indian Railway Com-

PANY, Limited, are prepared to receive TENDERS for the SUPPLY of :—

1. LOCKS, &c.
2. ACID OPEN-HEARTH STEEL BOILER PLATES.
3. SPARE PARTS of CARRIAGES and WAGONS.
4. STEEL TYRES for CARRIAGES and WAGONS.
5. ROLLED STEEL DISC WHEELS and AXLES for CARRIAGES and WAGONS (Metre Gauge).
6. HELICAL and VOLUTE SPRINGS.
7. CYLINDRICAL BUFFERS.
8. SPARE PARTS of LOCOMOTIVE ENGINES.
9. STEEL TYRES for LOCOMOTIVE ENGINES and TENDERS.
10. STEEL DRAW-BAR SHACKLES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Locks, &c.," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 7th September, 1923.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of Specifications Nos. 1 and 2 and of 10s. for each copy of Specifications Nos. 3, 4, 5, 6, 7, 8, 9, and 10.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, Consulting Engineers to the Company, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1. 3239

South Staffordshire Waterworks

COMPANY.

SINKING PUMPS.

The Directors of the South Staffordshire Waterworks Company invite OFFERS for the PURCHASE and REMOVAL from their Cannock Depot of TWO "GRIFF" PATTERN SINKING PUMPS, complete with Sling Chains, manufactured by Messrs. Joseph Evans and Sons, Wolverhampton.

The pumps have steam cylinders 21in. diameter and pump barrels 14in. diameter by 2ft. stroke, suitable for 300ft. head, and each pump will deliver 900,000 gallons in 24 hours.

Applications for permission to view can be obtained on application to the undersigned.

Sealed Offers, addressed to me and marked "Griff Pumps," should be delivered not later than 10 a.m. on Saturday, 25th August.

The Directors do not bind themselves to accept the highest or any Offer.

FRED. J. DIXON, M. Inst. C.E.,
Engineer-in-Chief.

Engineer's Office,
26A, Paradise-street, Birmingham,
8th August, 1923. 3263

PUBLIC NOTICES

Bombay Port Trust.

ENGINEERING ASSISTANT.

The Trustees of the Port of Bombay REQUIRE the SERVICES of an ENGINEERING ASSISTANT with good experience of Girder, Bridge and Roof Steel Work Design, Building Construction, and Heavy Masonry Work. Should preferably have obtained experience in connection with railway or dock work, and have been some time with a good contractor. Capable of preparing designs and drawings and making calculations under the direct supervision of an Executive Engineer. Salary, Rupees 850 per month, rising annually by Rupees 30 per month to Rupees 940, and, if married, with such married officer's house allowance as he may be eligible for under the rules of the service. Three years' agreement.—Applications, in writing only, stating age, education, technical qualifications, &c., with copies of testimonials, to the CONSULTING ENGINEERS, Bombay Port Trust, 2, Queen Anne's-gate, Westminster, S.W. 1. 3261

SITUATIONS OPEN

THE APPOINTMENT of ENGINEER ASSISTANT for an Indian Tea Estate has now been FILLED. P7834 A

WANTED for Anthracite Colliery in Spain, a COLLIERY MANAGER with experience, who can speak Spanish fluently. An excellent opening with good prospects for a young man with the necessary qualifications.—Address, stating experience, age, qualifications, and salary required, 3242, The Engineer Office. 3242 A

CIVIL ENGINEER WANTED, Thoroughly Competent, for large Pipe Line Contract. Only thoroughly qualified man, able to control men and costs, need apply. Salary £450 per annum to commence.—Box O 936, Les and Nightingale, Advt. Offices, Liverpool. 3211 A

ENGINEERING COMPANY (Old-established) REQUIRE the SERVICES of an efficient WORKS MANAGER who has had experience in the manufacture of Power Presses, Shear., and Sheet Metal Working Machinery in general or similar class of work. Suitable applicants must be proved organisers, have sound knowledge of the most up-to-date machine shop practice, possess tact and initiative, able to obtain maximum output, and have previously held successfully a similar position in works where modern methods of production are satisfactorily employed. Salary £750 per annum. Excellent prospects for thoroughly reliable works manager.—Address in first instance, stating age and fullest particulars of experience, present and past situations, together with copies of recent testimonials, 3241, The Engineer Office. 3241 A

FOUNDRY SUPERINTENDENT.—ADVERTISER under Box P7785 THANKS all APPLICANTS. Reply will shortly be sent to the selected candidate. 3277 A

RESEARCH ASSOCIATION OF BRITISH MOTOR AND ALLIED MANUFACTURERS, 15, Bolton-road, W. 4.—RESEARCH ENGINEERS WANTED. Salary £200-£500 according to qualifications.—Apply by letter only to DIRECTOR of RESEARCH. 3269 A

CONSTRUCTIONAL DRAUGHTSMAN. Must be energetic and have had sound theoretical training and practical experience in all classes of constructional steel work.—Apply, stating age, qualifications, and salary required, to FRODINGHAM IRON and STEEL CO., Ltd., Constructional Dept., Scunthorpe, Lincs. 3247 A

DRAUGHTSMAN WANTED IMMEDIATELY; accustomed to Designing Turbine Details. State age, experience, salary required, and when available. Apply, FRASER and CHALMERS ENGINEERING WORKS, Erith. 3232 A

DRAUGHTSMAN WANTED, First-class Man, with good experience of High-speed Steam Engines and General Engineering Work. Age 28-40 years. Thoroughly experienced men only need apply. State age, salary, references.—Apply, EASTON and JOHNSON, Ltd., Taunton. 3189 A

DRAUGHTSMEN WANTED; Required for Steel Caissons, Dock Gates and Heavy Opening Bridges, General Dock Construction Work, including Permanent Way and Buildings. Only men who have actually been recently engaged upon the design and detail drawings of such work need apply.—Applications, stating age, salary required, and full particulars of training and experience, and when at liberty, to STAFF MANAGER, Port of London Authority, London, E.C. 3. 3236 A

DRAUGHTSMAN WANTED, Preferably Experienced in the design and lay-out of Boiler-house Plants and Accessories, Mechanical Stokers, Coal and Ash-handling Machinery, &c. Good prospects to suitable man.—Address, stating age, experience, references, salary required, 3259, The Engineer Office. 3259 A

DRAUGHTSMAN WANTED, Experienced in Superheater Design. Give details of experience and salary required.—Address, 3262, The Engineer Office. 3262 A

FIRST-CLASS DRAUGHTSMAN, Experienced in the design and details of Impulse Turbines. Must be capable and efficient worker. State fully experience, age, and salary. Manchester district.—Address, 3274, The Engineer Office. 3274 A

FIRST-CLASS DRAUGHTSMAN REQUIRED, thoroughly accustomed to design of Mining and Concentration Plants.—Apply, giving particulars of age, experience, salary, &c., to FRASER and CHALMERS ENGINEERING WORKS, Erith, Kent. 3278 A

FIRST-CLASS MECHANICAL DRAUGHTSMAN REQUIRED for Transformer Dept.—State age, fullest particulars of experience, and salary required, to FERRANTI Limited, Hollinwood. 3244 A

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For continuation of Small Advertisements see page 3

A Seven-Day Journal

The Aerial Derby.

The eighth annual aeroplane race over a course around Outer London, beginning and finishing at Croydon, took place on Monday last, when a further speed record was achieved by Mr. L. L. Carter. The machine flown by Mr. Carter was a 20ft. span Gloster biplane with a 450 horse-power Napier Lion engine, and the two 100-mile circuits were completed in 1 h. 2 min. 23 sec., at an average speed of 192.4 miles per hour. The only other serious competitor was the Sopwith-Hawker machine, engined with a 400 horse-power Bristol Jupiter radial air-cooled engine, which was second in the race with a time of 1 h. 13 min. 9 sec., or an average speed of about 168 miles per hour. The handicap race, in which time is deducted from the actual flying times in accordance with the estimated capacity of the machine, was won by Captain H. A. Hamersley with an Avro machine fitted with a 200 horse-power Wolesley engine. This year is the third in which aeroplanes constructed by the Gloucestershire Aircraft Company have won the race on speed, and on each occasion an increase in speed has been recorded. Indeed, the record of this race since its beginning shows the astonishing progress which has been made in speed in a little over a decade. In 1912 the winning machine made 58.5 miles per hour, two years later 72.15 miles per hour was reached, and the post-war figures from 1919 to 1923 are 129.38, 153.45, 163.34, 179.5, and 192.4 miles per hour respectively.

Summer Storm Damage.

Considerable dislocation in the telegraph and telephone communications with Ireland and the North of England was caused by the summer storms of last week. On one day it was stated by the Post Office that only one telephone line was available on the London, Glasgow and Belfast system, whilst the nine lines connecting to Dublin were reported out of order by reason of damage both on the English and Irish sides. The disturbance was particularly felt in the North of England, and in Liverpool seven lines out of thirty-two were not working, while at Manchester nine out of twenty-five had failed. Newcastle reported seven lines out of order and three working. In all over fifty telephone lines were damaged throughout the country, and further disturbance was reported on two of the continental connections. Happily, much of the delay occasioned by such breakdowns will be avoided when the new underground cables which are now being laid by the Post Office have been got to work.

A Self-discharging Barge.

A novel type of tipping barge in which, by means of trimming tanks, a deck cargo consisting of about 300 tons of quarried stone may be automatically discharged to either side of the craft, was recently shipped to West Africa. It forms one of four such barges which will be used in connection with the building of a new breakwater at Takoradi by Stewart and McDonnell for the Crown Agents for the Colonies. These vessels were built at the Lytham Shipbuilding and Engineering Company, Limited, their construction and the tests on them being carried out by Flannery, Bagallay and Johnson, Limited, of London. The trimming tanks are arranged along either side and are divided into four by three transverse bulkheads. The design is so carried out that the bottom of the tanks is higher than the flotation level when the vessel is light. When loaded with deck cargo the ship is taken to the dumping site and sluice valves are opened, which admit sea water to the tanks on the side it is desired to discharge from. The barge is thus automatically careened to such an angle that the deck cargo is shot overboard, and, relieved of the weight, the vessel rises and empties the tanks. In tests made the cargo of stone referred to was discharged within thirteen minutes of the opening of the sluice valves and the ship was fully righted in two minutes after the load left the deck.

The French Railways.

The returns showing the revenue and expenditure of the French railways in 1922 are particularly interesting, since they represent the results obtained during the first year they were under the general control of the Conseil Supérieur des Chemins de Fer. It may be recalled that while the different companies preserve their autonomy, they are all under the direct control of the Conseil Supérieur, which aims at unifying as well as simplifying railway management and adopting a policy that will enable the companies to become self-supporting. Until 1921 the expenditure of the railway companies had always exceeded the revenue, and in that year the deficit was 900 million francs. Last year the revenue was 6948 million francs and the expenses 6545 millions, so that there was an excess of 403 million francs. All the companies showed a profit except the Midi and the State Railways, these latter showing a deficit of more than 152 million francs. The favourable results, so far as concerns the railway system generally, were due primarily to the increased traffic and also to the economies introduced by the Conseil Supérieur, which was able to reduce the burden of costly services and ensure a greater efficiency in the general organisation. Unfortunately, the big margin of receipts over expenditure was converted into a loss by the heavier capital charges, which left a total deficit of 1147 million francs, as compared with 2060 million francs in 1921. It is pointed out that this loss would have been completely retrieved and turned into a profit if the Government had not adopted the eight hours' day for railwaymen, contrary to the recommendation of the Conseil Supérieur des Chemins de Fer. As the railway debentures are no longer guaranteed by the State the losses are made good by a general fund to which all the railway companies contribute. Although the railway companies are not yet self-supporting, the progress made during the past year is so encouraging that there is every hope of the railway companies realising profits in the early future.

Colonel Pringle's Annual Report.

The comments of Colonel Pringle, Chief Inspecting Officer of the Ministry of Transport, on the railway accidents of last year were issued on the 3rd instant as a White Paper Cmd. 1926. We summarise it in another column. The most interesting part of it is, as usual, that which contains the remarks on the accidents that were inquired into. There were twenty-eight of them and their causes are allocated as follows:—Failure or insufficiency of engine or rolling stock equipment, six; failure or insufficiency of signalling or permanent way equipment, five; failure of enginemen to obey or observe "danger" signals, six; failure of enginemen to give effect to regulations, three; failure of signalmen to observe or give effect to regulations, three; failure of employees other than enginemen and signalmen to give effect to regulations, four; faulty methods of marshalling for high speed, one. In seven of these cases, it is remarked, a system of automatic train control would have prevented accident. Of the 568 accidents to railway servants inquired into it is difficult, says the report, to assign more than 4.94 per cent. to preventable causes.

New Cables for Italy.

A considerable development will take place, it is announced, within the next three years in connection with Italy's submarine cable service. According to a new convention between the Italian Telegraphic Cable Company and the Italian Government, which was signed in February of this year, the company agrees to lay three new important cables which will link up Italy with North and South America and with Greece and the East. The first cable will start from Fiumicino and will proceed by way of Malaga, Las Palmas, and the Cape Verde Islands to the island of Fernando de Noronha, off the Brazilian coast. From this point it will go southward to Rio de Janeiro, Montevideo and across the mouth of the Rio de la Plata to Buenos Ayres. We understand that the second cable will follow the same route from Italy as far as Malaga, after which it will pass to the Azores and be linked there—at least for the present—with the Western Union Company's cable to New York. The cable which will connect with Greece and the East will start from Brindisi. Up to the present Italy has possessed but few cable facilities, but the new extensions will remove many of the commercial disabilities which now exist.

Commercial Motor Lorries.

A scheme has been prepared by the War Office with a view of encouraging the commercial use of 30-cwt. motor lorries fitted with pneumatic tires. The War Office, it is officially announced, will pay a subsidy of £40 per year to all purchasers of approved vehicles or chassis of British manufacture, provided that the purchaser of such a vehicle enrols under the scheme which entitles the War Department to acquire such lorries in a national emergency, at a price fixed by agreement at the date of enrolment. It is proposed that enrolment under the scheme will be from year to year up to two years, but provision has been made whereby in exceptional cases the maximum period may be extended to three years. The department concerned has prepared specifications of approved vehicles which will be supplied to interested manufacturers.

London's Traffic Accidents.

In a Journal note of the 27th ult., dealing with safety in railway travel, we contrasted the small number of accidents on the railways for the year 1922 with the large number of fatal road and street accidents for the same year. In a statement issued on Saturday last the Commissioner of Police views with alarm the increase in London traffic accidents which the returns for the period January to April, 1923, show. In the three months referred to there has been an increase of twenty-two people killed as compared with the corresponding period of 1922. The accidents attributed to motor omnibuses have risen from nine in 1922 to twenty-two in 1923, while those caused by trade and commercial vehicles have increased from sixty-two in 1922 to eighty in 1923. In his report the Commissioner states that, whilst allowance must be made for the larger number of vehicles now using the streets, it must be apparent that drivers should pay far greater regard to the provisions of the law with respect to dangerous, reckless or negligent driving, or driving at a speed which may be dangerous when all the conditions which exist or may reasonably be expected to exist at the time are taken into account. It is further stated that, considering the very serious consequences of many of the accidents, the police have been instructed to check by all means in their power fast and dangerous driving.

The Unemployment Problem.

In our issue of July 27th we published a letter addressed to the Prime Minister by the Industrial Group of the House of Commons. This letter set forth the proposals which the group deems it necessary to take if the prospect of increased unemployment during the coming winter is to be adequately met. On August 1st a statement was made on behalf of the Government by Sir Montague Barlow, the Minister of Labour, when the lines it is proposed to adopt in dealing with the problem were made known. Speaking broadly, they are not dissimilar from the programme of last year, with the exception that an attempt will be made to help particular industries rather than localities. A feature of the plan outlined was the more generous financial assistance offered to revenue-producing schemes promoted by local authorities and public companies, where a substantial part of the expenditure will take the form of orders for materials which will give employment in the industries most seriously affected. A further letter, addressed to the Prime Minister by the Industrial Group, expresses its profound disappointment with the statement made by the Minister of Labour, and presses the extreme urgency of the problem. The group repeats its conviction that a vigorous and constructive policy of employment must be at once initiated by the Government, otherwise the whole social and economic life of the country will suffer irreparable damage.

West of Scotland Electricity Supply.

Following various meetings of the interested authorities, we learn that a conference of representatives of local authorities owning electricity undertakings and the various power companies will be held in the City Chambers at Glasgow on September 7th, to consider a scheme for a joint advisory board for the West of Scotland Electricity District. In the preliminary discussions of this scheme it was shown that the feeling of the majority of the engineers was in favour of an advisory board, the powers of which would not be so extensive or coercive as those of a joint authority might well be. The board proposed would comprise twenty-one members, with a constitution such that with certain exceptions there would be no interference with the management or working of the various electricity stations. With regard to the system of supply, we understand that 25-cycle current will be adopted in a certain part of the area, including Glasgow, and 50-cycle current in the other part, which includes Ayr, Greenock and Paisley. Provision is made in the scheme to be considered, for regulating new areas of supply, and for submitting to the board proposals relating to the establishment of generating or main transmission lines in the district. The board would investigate and make recommendations on such matters, but right of appeal to the Electricity Commissioners is secured to any constituent authority which may be affected.

Research on "Gob" Fires.

Arising out of the Maltby Main Colliery disaster which we recorded last week, a meeting of the National Executive of the Miners' Federation has passed a resolution calling upon the Government through the Mines Department to institute special research into the causes of "gob" fires with a view to their elimination. It is pointed out that, while much investigation has already taken place as to the best means of preventing such fires, in the judgment of the Committee some special research should be undertaken at once in the hope that the dread possibility of further disasters of this nature may be avoided.

The Otira Tunnel.

The Otira Tunnel in New Zealand, which is the longest tunnel in the British Empire and the seventh longest tunnel in the world, was formally opened for service on Monday, the 6th instant. It connects the east and west coast railway systems and is driven through the mountain range known as the Southern Alps at Arthur's Pass. This tunnel has a total length of 5 miles 554 yards and is constructed in the straight on a gradient of 1 in 33. The work of construction has been intermittent, the first shot having been fired at the Otira end as early as May 5th, 1908, and on July 20th, 1918, the two headings driven from Otira and Arthur's Pass met. The work of completion has included the complete electrification of 8¼ miles of line, including the portion in the tunnel, a 1500-volt direct-current overhead system being chosen.

Electricity in Mines.

No. III.*

One of the things to be aimed at when electrifying collieries is to avoid unduly lowering the power factor. Static condensers are sometimes employed to relieve the mains of wattless current; but with the advent of motors which are excited with direct current power factor difficulties have been minimised. The salient pole type of synchronous motor which has already been referred to is a machine which can run at unity power factor or draw a leading current. There is, however, another type of motor which is now made by most of the large number of electrical manufacturers, namely, the synchronous induction motor, which starts as an ordinary induction machine, and when full speed has been reached the exciter is switched on to the slip rings. By regulating the field current, leading or lagging currents can be produced in the stator and the power factor can be regulated within the limits corresponding to the rated output of the machine. A synchronous induction motor or "autosynchronous" motor, as some call it, was invented by Mr. Danielson about twelve years ago, whilst acting as chief engineer to the Allmanna Svenska Electriska Aktiebolaget Vesteras, Sweden, and is now supplied in this country by the Swedish General Electric Company, of 5, Chancery-lane, W.C.

Machines have been built for outputs ranging from 100 to 1500 horse-power, and two motors, each having an output of 850 brake horse-power and running at 900 revolutions per minute, were recently supplied to the waterworks of the Edmonton Corporation, Canada. These motors were designed for a leading power factor of 80 per cent. and are working on a 2200-volt, 60-cycle supply. With this power factor the guaranteed efficiency at full load was 93 per cent., at three-quarters load 91.7 per cent., and at half load 88 per cent. The efficiencies actually obtained on test, however, were 94.5, 93.6, and 91.9 per cent. respectively. An advantage of this type of motor is that if, on account of a sudden overload or drop in voltage, the machine falls out of step it will run as an ordinary induction machine. Tests on one of the motors just mentioned showed that it would stand an overload up to 1100 horse-power, when it pulled out of step and continued to run as an ordinary induction machine and then developed a maximum load of 2500 horse-power. When the load was again reduced to its normal value the motor automatically pulled into step and continued to run in synchronism.

The regulation of the excitation was obtained by shifting the exciter brushes, the exciter being a series-wound machine. In this manner resistance losses in the field circuit or in the main exciter circuit are avoided. The exciters fitted to these machines are liberally designed, and by over-exciting the field the overload of the machine, when running as a synchronous motor, can be increased to 1400 horse-power without the machine falling out of step.

Motors of this kind are well suited for driving fans and air compressors at collieries, and although in the case of air compressors the load fluctuates at frequent intervals from full load to 10 or 15 per cent. of that load, the leading component of the current supplied by the motor remains practically independent of these variations. In adopting this class of machine for power factor correction it is to be remembered that the magnitude of the component of leading or lagging current and the watt component stand in a very different proportion to one another at different power factors. The wattless component and the resultant component can be expressed in kilovolt-ampères at various power factors on the assumption that the watt component remains constant. A much larger leading component is required to correct the power factor from .9 to unity than is needed to correct the power factor from .8 to .9 or from .7 to .8. The size of the motor and consequently its cost depends upon its kilovolt-ampère rating, and in general it is the best plan to make use of "autosynchronous" or "synchronous induction" motors for leading power factors of not less than .7. Moderate-sized induction motors, for the same output would have a lagging power factor of about .85, and, if the power factor of the autosynchronous motor be fixed at .75 leading, the machine would be roughly 12 per cent. larger and consequently more expensive. The cost of the exciter also adds to the price.

To estimate roughly the amount of power factor correction obtainable with a given motor it is useful to remember that at a leading power factor of .7 the leading component of current produced, expressed in kilovolt-ampères, is denoted by the same figure which represents the output of the motor in kilowatts. A 650 horse-power autosynchronous motor with an output of 480 kilowatts would consequently give at .7 power factor a leading component of 480 kilovolt-ampères and would reduce the total lagging component of the system by that amount. If the power factor is larger than .7 leading, the leading component decreases and can easily be arrived at from the well-known graphical method. A low power factor results in transformers and feeders being overloaded on account of excessive currents, and another serious disadvantage is—and especially in the case of colliery installations, where a large number of motors are working intermittently and with fluctuating loads—that the current carrying capacity of the generators is limited to such an extent that the full capacity of the prime movers cannot be utilised. In such cases the employment of motors of the kind under consideration may save a large amount of money, notwithstanding that they are from 25 per cent. to 40 per cent. more expensive than an ordinary induction motor. Let it be assumed, for example, that the load on a given power station is 1000 kilowatts and that the power factor is .6, so that the output is 1670 kilovolt-ampères. Let it also be supposed that it is desired to add to this station an additional load of 500 kilowatts. If this load consists of ordinary induction motors with a power factor of .8, the resultant total load would be 2295 kilovolt-ampères and the power factor would be .665. But if autosynchronous motors with a leading power factor of .7 were used the resultant load on the power station would be 1700 kilovolt-ampères with a power factor of .88. The load could therefore be added by using autosynchronous motors without appreciably increasing the kilovolt-ampère output of the station. An illustration of one of these autosynchronous motors capable of developing 700 brake horse-power at a speed of 375 revolutions per minute is shown in Fig. 20. The machine is designed to run on a 5750-volt, 50-period circuit and is intended to give a leading power factor of .8.

Besides these autosynchronous motors, the Swedish General Electric Company, Limited, also manufactures induction motors for mining purposes, and Fig. 21 shows a 900 horse-power machine for winding, the guard which covers the slip rings being removed. The motor is designed to work on a three-phase,

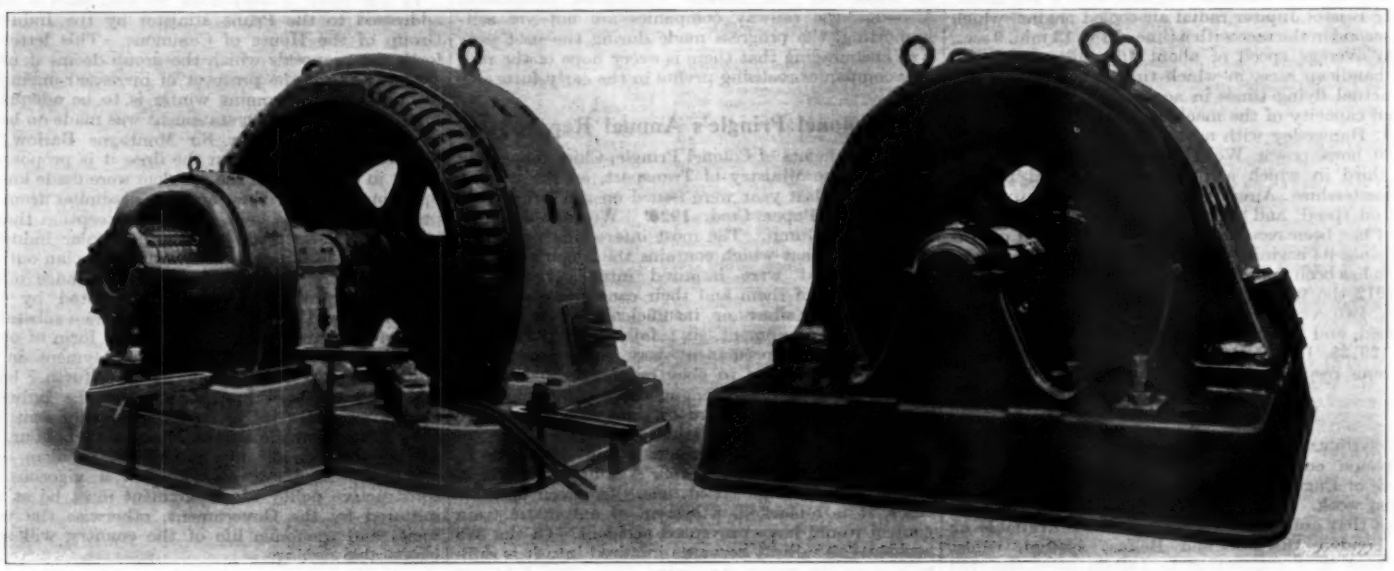


FIG. 20—700-H.P., 5750-VOLT, 50-CYCLE AUTOSYNCHRONOUS MOTOR

FIG. 21—900-H.P. SLIP-RING INDUCTION MOTOR

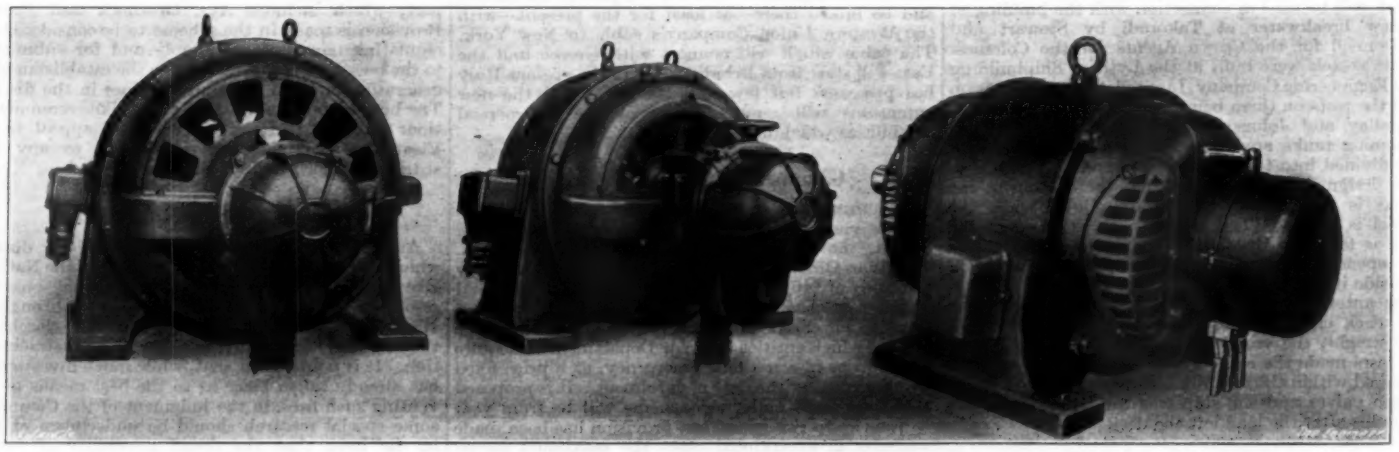


FIG. 22—HAULAGE MOTOR

FIG. 23—FLAME-PROOF PUMP MOTOR

FIG. 24—MOTOR FOR SURFACE WORKING

* No. II. appeared Aug. 3rd.

3000-volt, 50-cycle circuit and to develop 900 horse-power continuously when running at a speed of 375 revolutions per minute. Two motors of this kind have recently been built for a colliery in this country, each machine being designed to carry an overload of 100 per cent. for a period of sixty seconds without abnormal heating. Because of the intermittent nature of winding work, the motors have to withstand rapid reversals and rapid braking, and for this reason it is desirable to keep the fly-wheel effect down to a minimum value without sacrificing mechanical strength or rigidity. As the result of the switching operations induction motors for winding service have abnormal voltages set up in the end coils of the stator and rotor circuits, and to deal with these voltages the insulation of the stator and rotor windings on the machines under consideration has been reinforced where necessary. It was specified by the purchasers of these motors that the air gaps should be large, but this did not have a detrimental effect on the efficiency, which at the time of the test proved to be practically 95 per cent. There are three stator terminals on each side of the machine, so that the cable box can be fitted to the side which is most convenient for connecting up the cables, the three terminals on the opposite side being linked together to form the neutral point.

A typical example of one of the firm's haulage motors is shown in Fig. 22, from which it will be seen that the slip rings are placed outside the bearings and are enclosed in an explosion-proof chamber. To comply with the mining regulations guards are fitted over the end shields to prevent anyone coming into accidental contact with the rotating parts of the machine, at the same time to ensure adequate ventilation. The cover can easily be opened by a single man and the securing bolts are pinned to the cover, so that they cannot be taken away and be mislaid. Like the large motor just described, these haulage motors have three terminals on each side, and either set of terminals may be provided with a cable box for the main cables, whilst the other terminals may be linked together to form the neutral point of the winding. It will be observed from the illustration that a cable box is also provided for the rotor connections. These rotor cable boxes are removable and can either be mounted vertically as shown or may be turned through 90 deg. either to the right or to the left. The motors can therefore be arranged on site to suit the general conditions and the run of the cables between the machine switchgear or control apparatus. For haulage duty the machines are designed with extra large bearings and shafts, and the machines are rated so that they will develop two and a-half times full-load torque either during the starting or running period. Similar motors for haulage duty, but with the openings in the end shields covered with expanding metal, are also made. Another motor with flame-proof enclosures is shown in Fig. 23. This machine is for driving pumps, and for this service it is preferable for the brushes to be lifted from the slip rings and for the latter to be short-circuited after the machine has been started and has been brought up to full speed. The enclosed slip rings are therefore provided with a brush lifting and short-circuiting device, which is operated by a hand wheel mounted on top of the enclosure. The standard arrangement of cable boxes is also adopted on this machine.

The motor shown in Fig. 24 is for surface working or for use in non-fiery mines where explosion-proof covers are not essential. These machines are also used in ordinary industrial establishments. The slip rings are placed outside the bearings and are covered with a dustproof casing, and the handle to be seen on the top of this casing operates the brush-raising and short-circuiting device. It will also be noted that a substantial guard is fitted over the stator terminals. The rotor connections are brought out to three brass connectors, to which the cables are attached, and these connections can either be covered with insulating sleeves or be taped up in the usual manner. All these motors are fitted with ball bearings, with the result that they may be placed in any position, regardless of accessibility, for inspection of the bearings at frequent intervals is unnecessary. In such cases it is an easy matter to remove the ordinary handle provided for the brush-raising and short-circuiting and to fit a lever to the spindle so that the lever may be operated by means of wire ropes, this system of control being frequently adopted when motors are placed on a wall or when fixed in the roof of a factory. If the use of the brush-raising and short-circuiting device is inconvenient, the machines may be run continuously with the brushes bearing on the slip rings. When different forms of protection are required the same frame and end shields are used, it being simply necessary to change the guards over the openings in the end shields. With each type of mining motor a certificate is supplied of a test carried out at the factory by an independent consulting engineer.

A CASE of exceptionally rapid discharge of a ship's cargo at Birkenhead is reported in the *Steam Ship*. The ss. Gronsund arrived at Rea's Jetty at 12.15 a.m. on June 25th, with a cargo of 3400 tons of phosphate rock from Sfax. By 4.45 p.m. the same day, the whole of this cargo had been discharged into barges, the actual working time being 14¼ hours.

Locomotive Practice and Performance in France.

By J. T. BURTON-ALEXANDER.

No. II.*

ON THE PARIS-ORLEANS (*continued*).

On the Bordeaux line I was able to make a journey by the Sud Express. The load is the same as before the war—seven coaches, 275 tons—though the speed is much less, though increased since June 1st, 1923.

On Christmas Eve, with engine No. 3541, and a bad day, very thick and misty, we passed Juvisy, 11.1 miles, in 16 min. 40 sec., at a reduced speed of 27.9 m.p.h., speed having previously risen to 55.8 m.p.h.; Bretigny, 19.2 miles, in 27 min. 40 sec., at 43 m.p.h.; Etampes, 34.1 miles, in 45 min., speed having ranged between 54 and 59 m.p.h.; Monnerville, 42.8 miles, at the top of the 1 in 125, in 57 min. 20 sec., speed having fallen to 34.1 m.p.h. at the summit; Cercottes, 68.9 miles, in 85 min. 20 sec.; and Les Aubrais, 73.2 miles, in 92 min. 50 sec., in spite of a dead slow in the yard, costing one and a-half minutes. The pressure in the low-pressure cylinders was 30 lb. per square inch and our maximum speed was 60.2 m.p.h. Starting again, we passed La Chapelle, 4.9 miles, in 7 min. 15 sec., speed having reached 55 m.p.h.; Beaugency, 16.7 miles, in 20 min. 15 sec.; Blois, 36.6 miles, where speed was reduced to just under 50 m.p.h., in 41 min. 40 sec.; Amboise, 55.5 miles, in 61 min. 40 sec.; and St. Pierre des Corps, 69.5 miles, was reached in 76 min. 15 sec., exactly on time, our maximum speed having been 62.1 m.p.h. The boiler was full of water and the steam pressure was steady with very light firing.

From St. Pierre the engine was 3598, a post-war American-built 4–6–2 simple superheater, with 195 lb. steam pressure. The load was far too light for her to show what she could do, but in service the engines are doing well, though rougher riding than the French-built "Pacifics," perhaps on account of their having a trailing Bissel truck. This is being modified with satisfactory results. We passed Monts, 8.7 miles, mostly up 1 in 200, in 13 min. 15 sec., speed having risen to 45 m.p.h.; Port-de-Piles, 28.5 miles, in 34 min. 15 sec.; Chatellerault, 42.2 miles, in 49 min. 15 sec.; Clan, 55.2 miles, in 63 min. 5 sec.; and stopped at Poitiers, 62.7 miles, in 72 min. 40 sec., having made up two and a-half minutes from St. Pierre. Our minimum speed up the 1 in 200 was 48.8 m.p.h., with a maximum of 65.2 m.p.h. Poitiers was left two minutes late and we passed Iteuil, 8.7 miles, in 12 min. 30 sec., speed having risen to 55.9 m.p.h., our maximum as far as Angoulême; Couhé Verac, 21.1 miles, in 26 min. 10 sec., our speed having dropped to 50 m.p.h. at the top of 1 in 200; Ruffec, 40.9 miles, in 47 min. 15 sec.; Vars, 61.4 miles, in 70 min. 10 sec.; and stopped in Angoulême, 70.1 miles, in 80 min. 30 sec., one and a-half minute early. Here we were delayed by a joint in the steam heating pipe having to be replaced, and left three minutes late. We passed Charmant, 13.7 miles, in 18 min. 10 sec., our speed having risen to 52.1 m.p.h. at the top of the 1 in 200; Coutras, 50.9 miles, in 66 min. 55 sec.; Libourne, 61.8 miles, in 68 min. 10 sec., exactly on time; Vayres, 66.4 miles, where we had a stop and long dead slow for a bridge under reconstruction, and passed Bordeaux-Benauge, 81.9 miles, again dead slow for permanent way repairs, in 97 min. 40 sec. gross; and stopped in Bordeaux St. Jean, 83.1 miles, in 102 min. exactly, after the service stop outside and a very slow approach and start, or 95 min. net. Had he run more smartly down the hill, the driver could have made a punctual arrival at Bordeaux.

The re-ballasting of the Tours-Bordeaux line is being carried out with stone instead of gravel, and where the change has been effected a great improvement in the track is noticeable.

On the return journey, by the morning express, the engine was 3610, another American one, and the load, as far as Poitiers, eight coaches, 304 tons, packed with passengers. There two more coaches were added, making a load of 350 tons. This train stops at Bordeaux-Benauge; from there to Libourne we had a long permanent way slow near La Gorpe and the stop and slow for a bridge under reconstruction, so we were late into Libourne; a further delay occurred there owing to the steam heating system. We left Libourne six minutes late and passed Coutras, 9.9 miles, in 13 min. 25 sec., at a reduced speed of 46.5 m.p.h.; Parcoul, 25.4 miles, in 30 min. 30 sec., at 55.9 m.p.h.; Montboyer, 32.9 miles, in 38 min. 40 sec., at 50.7 m.p.h.; Montmoreau, 39.7 miles, at 43.4 m.p.h., the engine having been eased; Charmant, 47.2 miles, where we were two minutes early, in 55 min. 55 sec., our speed having risen to 52.1 m.p.h. at the top of the bank; and stopped in Angoulême, 60.8 miles, in 71 min. 35 sec., three and a-quarter minutes early. The steam pressure was constant and the water gauge was three-quarters full at the top of the hill. At Angoulême another American engine took us on to Tours.

These trains often load up to 500 and 550 tons, so our load was really too light to force the engine, as we were on time. Angoulême to Ruffec, 29.2 miles, took 44 min. 5 sec.; Ruffec to St. Saviol, 8.7 miles, took 11 min. 50 sec.; and from there to Poitiers, 33.2 miles, took 43 min. 40 sec., start to stop in each case. At Poitiers our load was increased, and we left eleven minutes late. We passed Chasseneuil, 4.9 miles, in 8 min. 5 sec., at 50.9 m.p.h., and stopped at Châtellerault, 20.5 miles, in 23 min. 35 sec., our speed having risen to 63.6 m.p.h. From there we passed Ingrandes, 3.7 miles, in 5 min. 30 sec., at 55 m.p.h.; Port-de-Piles, 13.6 miles, in 15 min. 25 sec., but there, for no less than eight minutes five seconds, we were reduced to 3.6 m.p.h. for signal replacement; Ste. Maure, 21 miles, in 33 min. 10 sec., up the 1 in 200, our speed rose to 45.9 m.p.h.; Monts, 33.5 miles, in 47 min. 15 sec., our speed being 55.9 m.p.h. at the summit; and stopped in St. Pierre des Corps, 42.2 miles, in 57 min., or 47½ min. net.

Another American engine, with a load of eleven coaches, or 410 tons, took us to Paris. Starting five and a-half minutes late, we passed Montlouis, 4.9 miles, in 9 min. 30 sec., our start being exceedingly leisurely; Amboise, 13 miles, in 19 min. 35 sec.; Onzain, 23.6 miles, in 41 min. 55 sec., at a speed of 52.1 m.p.h.; and stopped in Blois, 32.9 miles, in 42 min. 50 sec., our speed being 45 m.p.h. up the 1 in 200, before shutting off for the stop. From there we passed Menars, 5.5 miles, in 9 min. 15 sec., at a speed of 55.9 m.p.h.; Beaugency, 19.2 miles, in 24 min. 5 sec.; and stopped at Les Aubrais, 36.7 miles, in 43 min. 50 sec., after a relaying slow outside, thirty seconds early. We ran on to Paris in ninety-three minutes, with a stop and slow at Juvisy, keeping time exactly.

I was enabled to make a trip from St. Pierre to Bordeaux and back on two engines fitted for burning liquid fuel—"Mazout," a residue after the petrol and paraffin have been distilled from the crude oil. There are three engines fitted, two of the "3500" class and a "4500," all 4–6–2 compounds, but owing to the excessive cost of the fuel it is impossible for the moment to fit more. The steaming is improved, there is no dirt or dust, and, of course, the fireman's work is lessened to practically nil, except that he comes on duty earlier to light up his engine. The flame is shorter than from coal and there is no black smoke, except when the fireman cleans his tubes by throwing shovels of sand through a small hole in the fire-box door. This produces a momentary cloud of soot. The exhaust is fixed and not variable. The fire-bars are replaced by bricks and the smoke-box vacua are much higher than with coal firing on the same class of engine. The fire can be instantaneously increased or lessened and the water level in the boiler can be kept at half tube regularly, which benefits the superheater, though, curiously enough, the superheat is less than with coal.

One of the engines, No. 3569, is fitted with a turbine burner, the other two with ordinary burners. The turbine gives better combustion and is showing an economy in the running. When the regulator is shut there is no tendency to blow back through the fire-box door and no unpleasant sulphur fumes, but when pulling, the turbine and the burner are equally good, except from the point of view of economy.

On the run down the load was far too light to Bordeaux, and as we were on time the work was only interesting for the fact that the steam and water were constant in the boiler, and with so light a train and a coal fire the fireman would have had considerable difficulty in keeping so light a fire in order. The only interesting part was from Libourne to Bordeaux-Beneauge, 21.7 miles, booked at thirty-two minutes, but owing to the bridge rebuilding it was hard to keep time; Arveyres, 3.1 miles, was passed in four minutes, speed having risen to 55.9 m.p.h.; then came the slow for the bridge; St. Sulpice, 8.7 miles, in 16 min. 35 sec.; and were stopped in Bordeaux-Beneauge, 21.7 miles, in 32 min. 15 sec., 22½ min. net. Even if the load was only 280 tons, it was a fine effort of acceleration after having run over 150 miles.

The return trip was interesting, as the load was ten coaches, or 380 tons. The usual delays made us leave Libourne six minutes late, which forced us to climb fast to Charmant; we passed Coutras in 13 min., our speed having risen before to 62.1 m.p.h.; Parcoul, in 31 min. 20 sec.; Montboyer, in 38 min. 50 sec.; Montmoreau, in 45 min. 35 sec.; Charmant, in 54 min. 55 sec.; and stopped in Angoulême, after having eased before Charmant and having made an easy descent, in 71 min. 20 sec., or three and a-half minutes early. Our speed up the hill ranged between 55.9 and 60.9 m.p.h., while the vacuum in the smoke-box was 7.8in. and the water level was kept steady at half gauge. The pressure in the low-pressure cylinders was 30 lb. per square inch. As we were on time the running was easy from there on, time being kept with the utmost ease. From Châtellerault we passed Ingrandes in 6 min. 20 sec.; Port-de-Piles in 17 min. 45 sec.; Ste. Maure in 26 min.; Monts in 39 min. 30 sec., dead slow for relaying, and stopped in St. Pierre des Corps in 55 min. 30 sec. gross, one minute early. At Monts we had a slow on a rising gradient of 1 in 200, but with 45 lb. steam pressure in the low-pressure cylinders and the reverse levers of the high-pressure and low-pressure cylinders crossed and with a smoke-box vacuum of 9.8in., our speed rose to 43.4 m.p.h. within two miles.

From Tours we had a load of eleven coaches,

* No. I. appeared August 3rd.

458 tons, and engine No. 3575, and passed Montlouis in 8 min. 30 sec., Amboise in 17 min. 45 sec., Onzain in 29 min. 30 sec., and stopped at Blois, after an easy approach, in 42 min. From there we passed Ménars in 8 min. 45 sec., Beaugency in 23 min. 50 sec., and stopped at Les Aubrais in 45 min., or three minutes early. On to Paris time was kept exactly, in spite of a long slow after Juvisy.

Perhaps I may end these runs on the P.O. with some account of a run on the up Sud express from Bordeaux, made in the spring of 1914. The engine from Bordeaux was 3565, with a load of seven coaches, 275 tons, and we were eighteen minutes late starting. We passed Benauge in 3 min. 5 sec., Libourne in 24 min. 30 sec., Coutras in 34 min. 10 sec., Parcoul in 49 min. 30 sec., Montmoreau in 63 min. 35 sec., Charmant in 72 min. 55 sec., and stopped in Angoulême in 85 min. 15 sec. Before Libourne our maximum speed was 65.2 m.p.h., and our minimum up to Charmant 55.9 m.p.h., while running down to Angoulême we touched 69.5 m.p.h. From Angoulême we passed Vars in 11 min. 15 sec., Ruffec in 33 min. 20 sec., Couhé Verac in 53 min. 20 sec., Iteuil in 64 min. 30 sec., and stopped in Poitiers in 72 min. 50 sec. From there we passed Clan in 9 min. 15 sec., Châtellerault in 21 min. 45 sec., Port-de-Piles in 34 min. 35 sec., Monts in 53 min. 35 sec., and stopped at St. Pierre in 73 min., having made up ten minutes. The speed varied between 52 and 69 m.p.h. as absolute minimum and maximum, but was steady mostly at about 62.1 m.p.h. The vacuum in the smoke-box was between 2.8in. and 3.5in., and the pressure in the low-pressure cylinders 25 lb. to 30 lb. per square inch.

From St. Pierre the engine was 3532, and we passed Montlouis in 6 min. 55 sec., Amboise in 15 min. 15 sec., Blois in 36 min. 10 sec., Beaugency in 56 min. 10 sec., and stopped in Les Aubrais in 73 min., having exactly kept time. Our minimum speed up the 1 in 200 before Blois was 52 m.p.h. From Les Aubrais we passed Cercottes in 6 min. 30 sec., Etampes in 39 min. 35 sec., Bretigny in 53 min. 50 sec., Juvisy in 61 min. 35 sec., at the reduced speed of 37 m.p.h., and stopped in Paris-Austerlitz in 74 min. exactly, only four minutes late. The superheat pyrometer gave readings of between 280 deg. and 300 deg. Cent. The weather was fine, but a strong side wind was blowing.

On the Midi and P.O. I was specially struck by the evident pains that had been taken to train the firemen, and on the runs the improvement in the firing, as compared with much pre-war practice, was most noticeable.

On the P.L.M.

On the P.L.M. this winter I was able to make some interesting runs. The speeds are lower than before the war and the day Cote D'Azur Rapide has not been re-established, but the loads are very heavy, and from Marseilles to Nice the biggest engines possible until the bridge over the river Var is rebuilt are the "2500" class of 4–6–0 compounds, with small driving wheels. This bridge will, it is hoped, be ready for next winter's traffic. In January I made a short trip from Paris to Macon with the Mediterrannée train *de luxe*, or *Train Bleu*, with a load of nine coaches, or 478 tons, behind the tender and a bitterly cold night with mist in places. Starting from Paris, we passed Villeneuve St. Georges, 9.3 miles, in 14 min. 43 sec., speed having risen to 49.7 m.p.h.; Combes, 16.1 miles, in 24 min. 50 sec., speed having fallen to 34 m.p.h.; Melun, 27.9 miles, in 38 min. 30 sec., dead slow for the junction to Montereau *viâ* Hericy; Montereau, 50.3 miles, in 69 min. 50 sec., dead slow for the relaying of the permanent way out of the yard and station; Sens, 71.4 miles, in 96 min. 40 sec.; Cezy, 88.8 miles, in 115 min. 30 sec.; and stopped in Laroche, 93.5 miles, in 125 min. 30 sec. gross. The engine, 6412, was a 4–6–2 compound, the boiler pressure was steady at 225 lb., three-quarter gauge of water, and the high-pressure steam chest gauge marked generally 150 lb., and the low-pressure 30 lb., with 45 per cent. admission up the banks. While speeds touched 59.9 m.p.h. before Melun and 55.9 m.p.h. after, as maxima. From Laroche the engine was 6257, another compound, and we passed Brienon, 5.5 miles, in 10 min. 35 sec.; St. Florentin, 11.1 miles, in 17 min. 25 sec., speed having risen to 47 m.p.h.; Tonnerre, 26.1 miles, in 35 min. 55 sec.; Ancy, 39.8 miles, in 53 min. 25 sec.; Nuits-sous-Ravieres, 43.4 miles, in 57 min. 55 sec.; Montbard, 54.7 miles, in 70 min. 50 sec.; Les Laumes, 63.3 miles, in 83 min. 25 sec.; Verry, 77 miles, in 103 min. 15 sec., dead slow for bridge repairs; Blaisy Bas, 82.6 miles, in 116 min. 30 sec.; and stopped in Dijon, 99.3 miles, in 140 min. 55 sec., after a long slow to a walking pace through the summit tunnel at Blaisy.

The coal was not very good, and to get steam we had the variable exhaust up. It gave us the steam, but, of course, checked our speed owing to back pressure. As far as Les Laumes our cut-off was 40 per cent. in the high-pressure cylinders, with 165 lb. pressure in the high-pressure steam chest, and 37 lb. in the low-pressure. After the beginning of the 1 in 125 to Blaisy we had 150 lb. pressure in the high-pressure steam chest and our speed was 39 m.p.h. The slow at Verry is right in the middle of the gradient of 1 in 125 as far as Blaisy Station; from a slow to 6.2 m.p.h. our speed at Blaisy had risen to 29.9 m.p.h., with 210 lb. in the high-pressure steam chest and 75 lb. in the low. The slow in the tunnel was caused by work on the reinforcement of the permanent way by a bed of concrete 6ft. 6in. thick towards the southern end of the tunnel. From Dijon engine 6438 passed Gevrey, 6.8 miles, in 9 min. 50 sec.; Nuits St. Georges, 13.6 miles, in 17 min. 55 sec., speed having risen to 62.1 m.p.h.; Beaune, 19.8 miles, in 23 min. 40 sec.; Chagny, 32.3 miles, in 36 min. 45 sec.; Chalon, 42.2 miles, in 48 min. 10 sec., at a reduced speed of 12 m.p.h.; a relaying slow took place 53 min. 30 sec. from the start, and again at Tournus, 57.7 miles, passed in 71 min. 15 sec.; and we stopped in Macon, 77.6 miles, in 94 min. 40 sec. gross, or 88 min. 40 sec. net.

This train is so tightly coupled that the starting is difficult, but she runs easily once started, and a friend of mine in the train praised the easy running and comfort of this new sleeping car stock.

In April I made another run by the same train, with the load of nine coaches again, but 442 tons only, with engine 6424 from Paris. We passed Villeneuve St. Georges in 13 min. 30 sec., speed having risen to 55.9 m.p.h.; Combes, in 22 min. 30 sec., the speed being never less than 43 m.p.h.; Melun, dead slow, in 35 min. 30 sec.; Montereau, again dead slow and for even longer before and after, in 65 min. 30 sec.; Sens, in 92 min. 55 sec.; Cezy, in 101 min. 40 sec.; and stopped after an easy approach from there at Laroche, in 122 min. 40 sec., three minutes early. Our net time was 117 min. 40 sec. The cut-off was 45 per cent., with 150 lb. steam pressure in the high-pressure chest, until Sens, when it was reduced to 120 lb., and there was a three-quarter tube of water all the way with 210-240 lb. per square inch in boiler pressure. From Laroche, engine 6329, same class, passed Brienon in 8 min. 35 sec., speed having risen to 52 m.p.h., a smart start; St. Florentin in 14 min. 35 sec., Tonnerre in 31 min. 35 sec. A long permanent way slow occurred 42 min. 5 sec. from the start, but we passed Ancy in 51 min. 50 sec., Nuits-sous-Ravieres in 56 min. 30 sec., Montbard in 69 min. 50 sec., where we shut off for a moment; Les Laumes in 80 min., our speed having fallen to 34 m.p.h.; Verry in 99 min. 40 sec., dead slow, as before; Blaisy in 112 min. 15 sec., and after the tunnel slow stopped in Dijon fifteen seconds early, in 136 min. 50 sec. gross, or 125 min. net. Up the bank from Verry our speed rose to 28 m.p.h. with a pressure of 165 lb. in the high-pressure and 45 lb. in the low-pressure steam chests respectively. From Dijon our engine was 6456, and we passed Gevrey in 10 min. 50 sec., after a slow start, our speed having risen to 55.9 m.p.h.; Nuits St. Georges in 17 min. 40 sec., Beaune in 26 min. 5 sec., at 64.5 m.p.h. A long slow occurred 29 min. 10 sec. from the start; Chagny in 39 min. 20 sec., Chalon, dead slow, in 48 min. 40 sec., at 12 m.p.h.; Tournus in 80 min. 20 sec., and after another relaying slack to 25 m.p.h., stopped in Macon, 93 min. 10 sec. from the start, or 88 min. net, allowing nothing for the service slow at Chalon. From Macon we passed Creches, 4.3 miles, in 6 min. 35 sec., at 60.8 m.p.h.; Belleville, 14.2 miles, in 16 min. 55 sec.; Villefranche, 22.2 miles, in 26 min. 15 sec., dead slow for relaying; St. Germain-Mont-d'Or, 32.3 miles, in 36 min. 30 sec., at 12 m.p.h., for the service slow for the slow line; but from there we were stopped and checked by signals, so only reached Lyons-Brotteaux, 44.7 miles, in 65 min. 30 sec. gross, or 51 min. 30 sec. net, from Macon. From Brotteaux the line is hopeless for any speed till St. Fons, 3.7 miles, which we passed in 15 min. 10 sec., constant slacks and slows reducing our speed; Chasse, 13.6 miles, where there is a service slow, was passed in 25 min.; Vienne, 19.8 miles, in 32 min. 50 sec.; a permanent way slow occurred 48 min. 25 sec. after the start; St. Rambert, 37.8 miles, in 54 min. 10 sec., where our speed reached 62.1 m.p.h.; Tain, 54.6 miles, in 71 min. 10 sec.; and we stopped in Valence, 66.4 miles, in 82 min. 40 sec. From Valence our running was smarter, as the train in front was not checking us, and we passed Portes, 3.7 miles, dead slow, in 6 min. 20 sec.; Montélimar, 27.3 miles, in 30 min. 30 sec., our speed having risen to 64.5 m.p.h.; Bollène, 47.8 miles, in 49 min. 25 sec.; but at 58 min. 45 sec. from the start a long signal slow occurred, speed having reached 68.5 m.p.h.; Orange, 59.6 miles, in 65 min. 15 sec.; Le Pontet, 73.2 miles, in 87 min.; and, after a slow approach, stopped in Avignon, 76.6 miles, in 84 min. 30 sec. gross, or 79 min. net. The steam pressure was 120 lb. in the high-pressure chest and the boiler 210-230 lb., with 45 per cent. admission and a full gauge glass. On this section trials are being carried out with other companies' engines, and I am told that they have made the run from Lyons in 148 minutes; but, of course, it must not be forgotten that we knew we had another train in front of us, which was in Avignon Station when we arrived, ready to start again for Marseilles and Nice.

From Avignon engine 6279 passed Tarascon South Junction, 13.6 miles, in 18 min. 35 sec.; Arles, 20.5 miles, dead slow for bridge repairs, in 27 min.; Miramas, 42.2 miles, in 53 min. 20 sec.; Rognac, 58.4 miles, in 68 min. 5 sec.; a permanent way slow for relaying occurred at 61 min. 5 sec.; Pas-des-Lanciers, 63.9 miles, in 77 min. 45 sec.; L'Estaque, 68.3 miles, in 83 min. 30 sec.; and, after the usual easy approach, stopped in Marseilles, 74.5 miles, in 92 min. 55 sec. gross, or 85 min. 55 sec. net. Before Tarascon our speed rose to 64 m.p.h., and after Miramas to 68.3 m.p.h. The high-pressure chest pressure was 135 lb., with 240 lb. in the boiler. Owing to the train in front, it was useless to run harder, but it was good work only to be slowed once by signals between Lyons and Marseilles with another train only ten minutes or less in front.

From Marseilles to Cannes, where the express running ceases, the time-table is not severe; but in case of previous delays, time can be, and is, made up to very large extents, though the new service slows at La Blancarde and Aubagne to 12 m.p.h. make the timing to Toulon much harder. On the train *de luxe*, with a load of nine coaches, or 478 tons, and engine No. 2437 of the "4–6–0" class, we were seven minutes late out of Marseilles and passed the Toulon Junction, .6 miles, in 2 min. 10 sec.; La Blancarde, 2.4 miles, in 5 min. 40 sec., at reduced speed; Aubagne, 10.5 miles, in 21 min. 30 sec., in spite of a permanent way slow; Cassis, 16.7 miles, in 32 min. 35 sec.; St. Cyr, 27.3 miles, in 42 min. 40 sec.; Ollioules, 36 miles, in 53 min. 55 sec.; and stopped in Toulon, 41.6 miles, in 61 min. 35 sec. Up the 1 in 125 to the summit at Cassis we had 195 lb. pressure in the high-pressure and up to 40 lb. in the low-pressure cylinders, with an admission of 60 per cent. in the high-pressure cylinders, and our speed rose to 31 m.p.h. at the summit, with a boiler pressure of 225-240 lb. per square inch. On the descent we maintained the maximum speed authorised, viz., 62.1 m.p.h. As we were already two minutes early at Toulon, the climb to Carnoules, 21.7 miles, was taken easily at a minimum of 26 m.p.h., in 44 min. 30 sec., in spite of a distant signal which was at "danger" and caused a slack. St. Raphael was reached before time and Cannes one minute early.

On another occasion, with engine No. 2525 and nine coaches, or 442 tons, we passed La Blancarde in 7 min. 50 sec., Aubagne in 23 min. 30 sec., Cassis in 35 min. 20 sec., and were stopped at St. Cyr by signals in 47 min. 20 sec. Starting again, we passed Ollioules in a gross running time of 63 min. 40 sec., and stopped in Toulon in 71 min. 25 sec. gross. From Toulon we passed La Pauline, 6.8 miles, in 19 min. 40 sec., including a dead stop of 2 min. 10 sec. for signals; Cuers, 14.2 miles, in 34 min. 40 sec.; and stopped at Carnoules, 21.7 miles, in 47 min. 40 sec. Our lowest speed up the long bank was 33.5 m.p.h. From Carnoules we passed Les Arcs, 21.1 miles, in 26 min. 15 sec.; Puget, 32.3 miles, in 39 min. 20 sec.; and stopped on time at St. Raphael, 37.2 miles, in 47 min.; the 19.8 miles on to Cannes took 31 min. Up the hill to Carnoules the boiler pressure was steady at 240 lb. per square inch, with 37 lb. per square inch in the low-pressure cylinders. On the up journey, with a first, second, and third-class express, No. 2459, with a load of twelve coaches, or 458 tons, ran from Frejus to Les Arcs, 13.6 miles, in 23 min. 20 sec.; on to Carnoules, 21.1 miles, in 46 min. 50 sec.; and down to Toulon, 21.7 miles, in 25 min. 45 sec. From Toulon we passed Ollioules, 5.5 miles, in 10 min. 10 sec.; Bandol, 9.9 miles, in 16 min. 15 sec.; St. Cyr, 14.2 miles, in 24 min. 10 sec.; Cassis, the top of the hill, 24.8 miles, in 39 min. 10 sec.; Aubagne, 31 miles, in 50 min. 15 sec.; and stopped at La Blancarde, 39.1 miles, in 61 min. 20 sec., in spite of a permanent way slow after Aubagne, having made up 8 min. 40 sec. gross on the booked time, or two minutes more net.

On a First-class Rapide this spring, with engine No. 2648 and a load of nine coaches, or 342 tons, we passed Puget from St. Raphael, 4.9 miles, in 7 min. 15 sec., at 52 m.p.h.; Le Muy, 11.1 miles, in 13 min. 50 sec.; Les Arcs, 16.1 miles, in 25 min., with a signal stop two minutes after Le Muy; Le Luc, 25.4 miles, in 44 min. 15 sec., in spite of another signal stop thirty-five minutes from the start; and stopped in Carnoules, 37.2 miles, in 62 min. gross, our speed on the bank never having fallen below 37 m.p.h. and at one point rising to 40 m.p.h. From Toulon we passed Ollioules, after a signal stop, in 11 min.; St. Cyr, where we were stopped by signals, in 25 min. 40 sec.; La Ciotat, 18.6 miles, in 33 min. 40 sec.; Cassis, at 37 m.p.h., in 45 min.; Aubagne, in 52 min. 30 sec.; La Blancarde, in 60 min. 15 sec.; and stopped in Marseilles, after a signal stop and further slows, in 70 min. 40 sec. gross, or 58 min. net. These are fine runs for small engines which have been running now from pre-war days, with coal of often an inferior grade.

From Marseilles, with the same train, but with the load increased to twelve coaches, 473 tons, and engine 6154, an old four-cylinder non-compound, with only 180 lb. pressure, but fitted with the new variable exhaust, we passed L'Estaque, 6.8 miles, in 13 min. 45 sec., at 38 m.p.h.; Pas-des-Lanciers, 11.8 miles, in 20 min. 45 sec.; Rognac, 17.3 miles, in 28 min., our speed being 40.3 m.p.h.; and were stopped by signals at Raphele, 48.4 miles, after a previous signal stop of 6½ min., in 71 min. 15 sec. gross. After standing for 1 min. 10 sec., we re-started, and passed Arles, 53.4 miles, in 84 min. 45 sec.; Tarascon South Junction, 61.4 miles, in 94 min. 45 sec.; and stopped in Avignon, after a slow approach, 74.6 miles, in 114 min. gross, or 100 min. net. Our speed never exceeded 50.9 m.p.h., but without screwing up the exhaust our steam pressure was constantly at blowing-off point with plenty of water in the boiler, a great improvement on the old state of things.

From Avignon, 6431, a compound, came on and passed Le Pontet, 3.1 miles, in 8 min. 35 sec., at 37 m.p.h.; Orange, 17.3 miles, in 26 min. 10 sec., at 56 m.p.h.; Pierrelatte, 36 miles, in 46 min.; Monté-

limar, 49.7 miles, in 63 min., having eased off as we were early; Livron, 66.4 miles, in 89 min. 30 sec.; and, after the slow for Portes, stopped in Valence, 76.6 miles, in 103 min. 15 sec., having made up ten minutes from Avignon before passing Montélimar. The pressure in the high-pressure was 105 lb. and 30 lb. per square inch in the low-pressure cylinders. The boiler pressure was constant at 240 lb. and the gauge glass was full of water, though the coal was mostly slack. Our maximum speed was 59.5 m.p.h. Time was easily kept to Lyons, Tain, 11.1 miles, being passed in 19 min. 15 sec.; St. Rambert, 27.9 miles, in 40 min. 15 sec.; Chasse, 52.7 miles, slow, in 75 min. 5 sec.; and Lyons Perrache, 65.8 miles, was reached in 97 min. exactly.

Here the dining car came off and with the load reduced to eleven coaches, or 427 tons, engine 6360 passed Lyons-Vaise, 3.1 miles, in 6 min., at 49.7 m.p.h.; St. Germain, 12.4 miles, in 16 min. 40 sec., at 59 m.p.h.; Villefranche, 21.1 miles, in 25 min. 20 sec.; and stopped at Macon, 44.7 miles, in 55 min. 20 sec., after an easy approach, being four minutes early. The pressures were 150 lb. and 30 lb. per square inch in the high-pressure and low-pressure cylinders respectively. We reached Paris three minutes before time.

On another occasion from Avignon, engine 6430, with the load of ten coaches, or 374 tons, passed Le Pontet in 6 min. 10 sec.; Orange in 23 min. 55 sec., at 52 m.p.h., after which we had a long signal slow and stop; Pierrelatte, in 50 min. 35 sec., the speed having reached 55.9 m.p.h.; Montélimar in 67 min. 10 sec., the signals just coming "off" for several sections; Livron in 89 min.; and, after the slow for Portes, stopped in Valence in 104 min. gross, or 98 min. net. The pressure in the high-pressure and low-pressure cylinders respectively was 180 lb. and 37 lb. per square inch, with 35 per cent. admission in the high-pressure cylinders, the boiler pressure being 225-240 lb. per square inch, and the gauge glass three parts full. We were exactly on time at Valence, but we left four minutes late, owing to the express in front of us, and on to Lyons we were much hindered by this train. At Lyons our load was increased to fourteen coaches = 506 tons. We passed Lyons-Vaise in 7 min. 10 sec., at 36 m.p.h., and immediately ran into disarranged signals with stops and slows, but passed St. Germain in 33 min. 45 sec. gross; Villefranche in 43 min. 50 sec., at 55.9 m.p.h.; but 54½ min. from the start we had a long slow and stop for a goods train which had not cleared. Starting again, we passed Creches, 40.3 miles, in 77 min. 15 sec., and stopped in Macon in 82 min. 30 sec. gross, or 56 min. 30 sec. net. The pressures in the high-pressure and low-pressure cylinders were 180 lb. and 37 lb. respectively, with a full glass of water and full head of steam. Our maximum speed was 57.1 m.p.h. Owing to the bitter cold of the winter night, and having already gone over 300 miles on the footplate, I got into the train, which was thirty-one minutes late, but by Laroche we were on time and finally ran into Paris very easily, three minutes early.

It will be noticed how very similar the cylinders pressures are in the case of most of these runs. Unfortunately, there were no pyrometers to record the superheating.

From Marseilles to Cette 4–6–0 engines of class "2600" are used on the expresses, and I had an interesting run on the day Marseilles-Bordeaux Rapide, on a day of furious gale, which was so rough that the loads were reduced by 25 per cent. Engine 2639, with a load of nine coaches, or 335 tons, from Marseilles, passed L'Estaque in 14 min. 50 sec.; Pas-des-Lanciers in 21 min. 50 sec., at 49.3 m.p.h.; Rognac in 28 min. 5 sec., speed having risen to 60.2 m.p.h.; Miramas in 47 min. 45 sec.; and stopped in Arles, after a permanent way slow six minutes before, in 74 min. 15 sec., or 72 min. 15 sec. net. We ran the 8.7 miles to Tarascon Station in 14 min. 20 sec., with a dead slow for the junction with the main line, and reached a speed of 48.4 m.p.h. The gale here was at full force. From there we passed Jonquières, 7.4 miles, in 14 min. 50 sec., our maximum speed up the bank of 1 in 135 being 31.1 m.p.h.; and stopped at Nimes, 17.3 miles, in 28 min. 30 sec. From there to Cette time was easily kept, in spite of slows and the gale, but the booking is fairly easy. The pressure in the low-pressure cylinders was 37 lb. per square inch, with never less than half a tube of water, and the pressure of the boiler not under 225 lb. per square inch.

The same engine on the up train from Cette with ten coaches, or 374 tons, ran from Cette to Montpellier, 17.3 miles, in 26 min.; Montpellier-Lunel, 14.3 miles, in 21 min. 30 sec.; Lunel to Nimes, 16.1 miles, including a dead slow for a new bridge, in 29 min. gross, or 26 min. net; and Nimes to Beaucaire (just before Tarascon), 15.5 miles, in 20 min. 30 sec.—good work for an old pre-war engine.

I must mention the very easy riding of the P.L.M. 4–6–2 engines of the "6000" class. It is not tiring at all. The vibration is very small, and even after twelve hours on end, Paris-Marseilles, I have continued on the footplate to Nice, almost sixteen and a-half hours on end, without being overtired.

The firing has evidently been very carefully taken in hand and a great improvement is obvious. Steam is more regularly maintained, the water level is higher on the average, and the coal consumption is not excessive. I understand that trials show a considerable economy on the part of the various compound superheater classes of engines, as compared with similar engines which are built as non-compounds.

During the war the 4–6–2 engines ran without a change from Dijon to Paris and back, only stopping to take water at Laroche, with trains which loaded up to 720 tons behind the tender, and with these heavy loads the speed on the 1 in 125 gradient from Dijon to Blaisy was maintained at 24.9 m.p.h. As the trains were packed with standing passengers, the total load must have exceeded 750 tons.

With loads of 500 tons and over the question of Laroche-Dijon, from the point of view of the adhesion of 4–6–2 engines, is a troublesome one, and it is possible some development may be found to be necessary in the not far distant future.

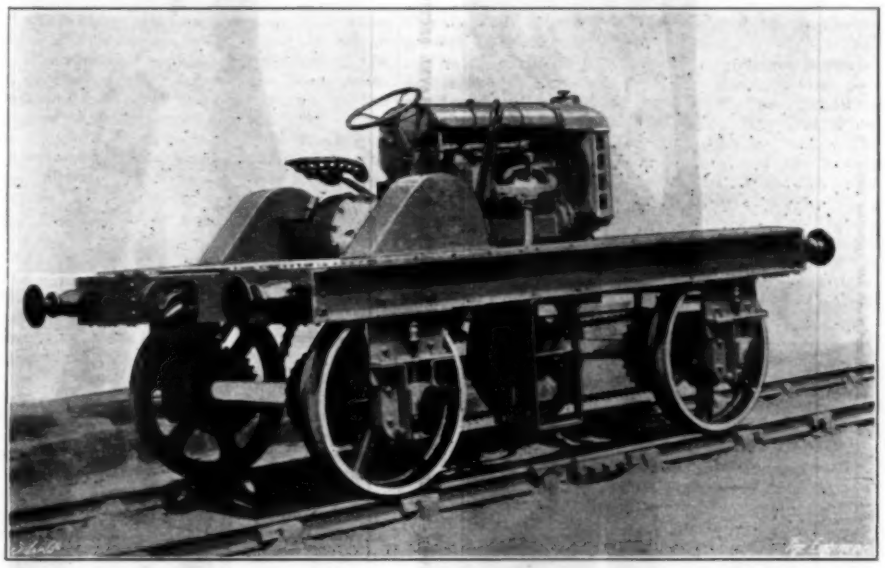
These runs were made in two periods, and on the later occasion I was pleased to note how much smarter the running was from every point of view.

On the Dijon-Vallorbe-Pontarlier line the new 2–8–2 engines are used instead of the 4–6–2's, and are doing fine work. I hope to be able to make some notes which will be as interesting as those I last published, just before the war in 1914.

A Novel Locomotive.

We have received from Messrs. Lake and Elliot, of Braintree, the photograph, reproduced herewith, of a locomotive built up by the firm, and at present being used on the maker's sidings. The first time it was tested, loaded trucks of a total weight of 90 tons were shunted.

The chassis, as distinct from the power plant, has been designed on railway engineering principles, so as to provide the necessary weight for traction purposes, and to give facilities both for haulage and propelling. It will do anything that an ordinary steam shunting locomotive will do, and it has displaced a steam locomotive which cost £2500 second-hand. The power plant is the Fordson tractor. Messrs. Lake and Elliot tell us that they have not yet worked out the final figures, but that they estimate that they may be able to sell the complete job for £300 or under, plus the cost of the tractor, which is at present priced at £120. This price is subject to reduction to the extent of the amount realised by the sale of the wheels.



A NOVEL PETROL LOCOMOTIVE

Railway Accidents in 1922.

The following is a *résumé* of the report by the Chief Inspecting Officer, Ministry of Transport, on the accidents that occurred on the railways of Great Britain during the year 1922.

The accidents are grouped under the three main heads of:—(1) Train accidents; (2) accidents caused by the movement of trains and railway vehicles, exclusive of train accidents; and (3) accidents on railway premises not due to train accidents or to the movement of trains and railway vehicles.

The total number of persons killed or injured by accidents in connection with the working of railways were:—

	1922.	1921.	Increase or decrease.
Killed	728	765	− 37
Injured	19,462	18,973	+ 489

The twenty-eight train accidents which were inquired into by the Inspecting Officers of the Ministry may be allocated, in respect of primary cause, as follows:—

(*a*) Failure or insufficiency of equipment—	
(1) Engine and rolling stock	6
(2) Signalling and permanent way	5
(*b*) Failure of enginemen to obey or observe danger signals	6
(*c*) Failure of enginemen to give effect to regulations	3
(*d*) Failure of signalmen to observe or give effect to regulations	3
(*e*) Failure of employees other than enginemen and signalmen to give effect to regulations	4
(*f*) Faulty method of marshalling for high speed ...	1

In seven of these cases—or 25 per cent.—a system of automatic train control would have prevented accident. The use of a continuous brake on freight trains would have prevented two of the accidents. Improvements in design, in material, and in methods of examination and of fastening are noted as likely to have beneficial effect in five cases. A modern type of facing point equipment would have prevented one accident, and an alteration in the method of working movable diamond points would have prevented a second.

The general conclusions are:—(i.) In respect of maintenance of equipment, there is still, in certain directions, some leeway to make up before the high pre-war standard is attained; (ii.) the need of a system of automatic train control as a method of providing greater security against accident continues to be proved.

During the year 568 inquiries were held by officers of the Ministry into accidents caused by the movements of trains. It is difficult, according to the report, to assign more than 4.94 per cent. of the accidents to preventable causes, but in all such cases recommendations were made, and necessary action, where reasonably practicable, was taken with good effect. Many cases of accidents into which formal inquiry was not made were dealt with by correspondence with good results.

It is satisfactory to note that substantial reduction in the number of cases of accidents under this heading, fatal and non-fatal in character, continues to be general as compared with years prior to 1921. The great bulk of the casualties to passengers in this class are due to misadventure, or are caused by want of caution, or misconduct on the part of the persons concerned. During 1922 there were 24 fatal and 40 non-fatal cases of casualty by falling out of carriages during the running of trains. They include accidents caused not only by failure of door fastenings, but also cases of misconduct, such as drunkenness, overbalancing when seated on a carriage window, unproved suicide, and evasion of ticket collection. It is not, therefore, considered that the figures justify pressure being brought to bear on railway companies to adopt one of the numerous patents for controlling the locking and unlocking of carriage doors, more especially as such devices may add to the difficulty of the rescue of passengers in case of accident.

As regards servants of the companies, 69.5 per cent. of the total accidents are similar in origin to those incidental to any industrial enterprise, and no considerable reduction can be expected. In 25.67 per cent. of the cases the accidents were attributable to want of caution, and these could be reduced. The desirability of education in personal carefulness is again emphasised.

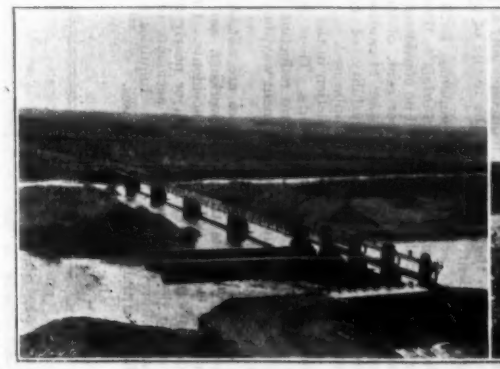
There has been a further reduction in the total cases of coupling and uncoupling accidents. There also continues to be a considerable and uniform reduction in accidents to men engaged upon the permanent way, but the number is still lamentably high.

Accidents on railway premises are not, for the most part, attributable to railway working, and should not properly be classed as railway accidents. Of the 13,054 non-movement accidents, 12,484, or nearly 96 per cent., may be described as industrial accidents of a more or less non-preventable character. Inquiries were held by officers of the Ministry into 55 cases.

An article in the *Engineering News-Record* suggests that the project of bridging the mile-wide opening of the Golden Gate of San Francisco Bay is again to the fore. The city engineer of San Francisco has drawn public attention to a plan for a 4000ft. span across the Golden Gate, which, it is claimed, would cost some 25,000,000 dols. Two other schemes, using a position somewhat inside the Gate, and more nearly in the natural line of traffic, would provide even cheaper crossings, and do so by more approved methods, though following a somewhat longer water route.

THE LETHBRIDGE IRRIGATION WORKS—EFFECTS OF A HEAVY FLOOD

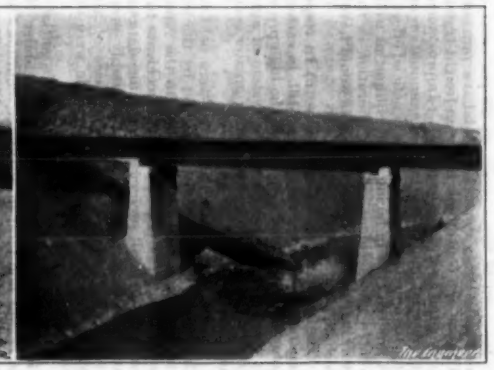
(For description see opposite page.)



INTAKE WORKS, MAY 2nd

OLDMAN RIVER FLUME, MAY 2nd

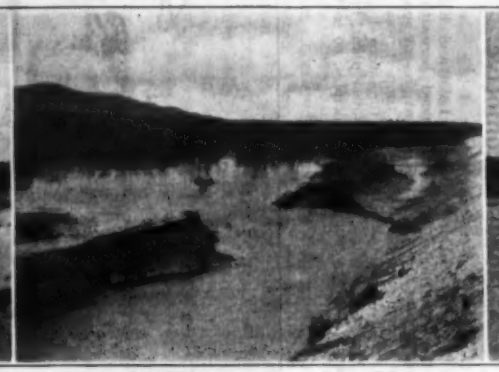
WATER REACHING GRAVEL SECTION OF CANAL, MAY 2nd



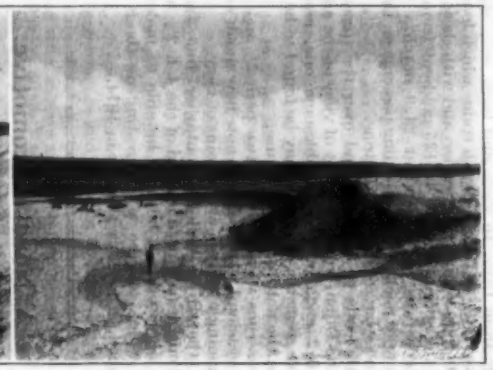
BLOWING UP WEED JAM IN CANAL, MAY 3rd

SLIDE OF BANK AT MILE 3, MAY 9th

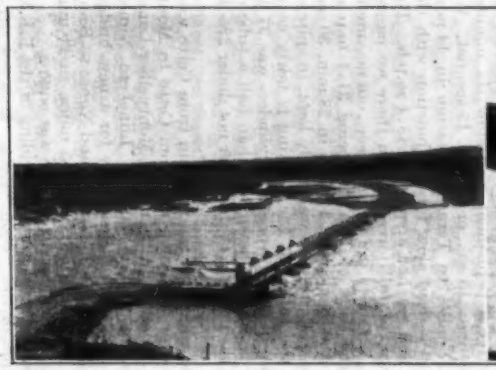
BREACH AT MILE 1.5, JUNE 1st



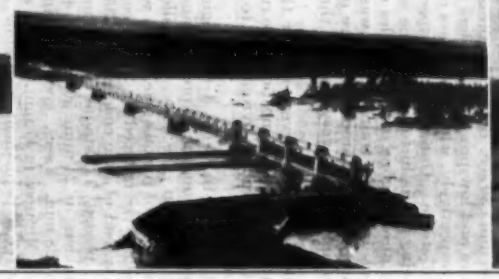
BREACH AT MILE 1.7, JUNE 1st



BREACH AT MILE 2, JUNE 1st



DOWNSTREAM FACE OF DIVERSION WORKS, JUNE 1st



UPSTREAM FACE OF DIVERSION WORKS, JUNE 6th

BREACH AT HEADGATES, LOOKING DOWNSTREAM, JUNE 6th

BREACH AT HEADGATES, LOOKING UPSTREAM, JUNE 8th

The Lethbridge Irrigation Enterprise in Western Canada.

By F. S. DYKE, Assoc. M. Eng. Inst. of Canada.

No. II.*

In our first article we stated that it was intended that the Lieut.-Governor of the Province of Alberta should inaugurate the commencement of operation of the irrigation undertaking, by an official opening of the outlet gates at Keho Lake Reservoir on June 16th, exactly two years from the beginning of construction. Unfortunately a record flood came down at the end of May causing damage to the main canal bank which will delay the opening of the project for more than two months. The main canal head-gates were first

CLEARING WEED-JAM WITH HORSE FORK

opened at 9 a.m. on May 2nd, 2.5ft. of water being admitted to prime the channel. The headwave entered the Oldman Flume, 4 miles distant, at 7.30 the same evening.

It was explained in the first article that this portion of the canal is in steep hillside construction, with only one bank, the required discharge being 807 cusecs, the bed width 31ft., the depth of water 7ft., and the inside slopes 1½ to 1. The value of n was taken as .0225, giving a theoretical velocity of 2.85ft. per second. As was anticipated the seepage losses on this stretch were considerable owing to the gravelly nature of the material composing the bank, but thereafter the water advanced steadily at the rate of about .4 miles per hour, being turned back to the river for short periods through the spillways at mile 13 and mile 25.2 to rid the stream of floating weeds. The headwave eventually reached Keho Lake Reservoir, 53 miles from the intake on the evening of May 8th, some 130 hours after the opening of the head-gates.

During the operation of priming, the banks were patrolled continuously day and night, but the only difficulty encountered was from a few weed jams against the piles of road bridges. The weed responsible for this trouble is known locally as Russian thistle, which spreads with alarming rapidity on all uncultivated land from which the original prairie grass has been removed, and grows to a height of about 2ft. The parent plant dries up and dies early in autumn, and under the action of the high winds prevalent at that season, breaks off at the root, and is deposited in great masses against any excavations or obstructions, such as fences and bridges, forming piles sometimes 12ft. to 15ft. in height. All such piles were carefully removed and burnt before priming, but despite these precautions several bad jams of saturated weeds occurred which necessitated the use of large horse-drawn forks to remove them. Measurements taken with the current meter on May 7th showed the discharge 2½ miles from the intake to be 222 cusecs, which was reduced to 157 cusecs at mile 7, at the end of the gravel section, and to 107 cusecs at Willow Creek Flume at mile 14.5. Owing to the difference in material the loss between this point and Keho Lake was proportionately small, but probably only 40 cusecs actually entered the reservoir.

Early on the morning of May 9th the outer half of the high fill at mile 3 slid out, the material having practically no angle of rest when in a saturated state, and was carried out over 200ft. from the original toe of the embankment. Water was immediately turned off at the head-gates, and about twenty-five teams put to work to repair the bank. Several hundred loads of boulders were dumped along the outer third of the base to form a blind drain, and thus steepen the plane of saturation, and fresh material was taken from a waste cut nearby to complete the embankment, the outside slope being increased to 3½ to 1. Clay was also hauled from some distance to give a puddle lining to the canal prism at this point. On the morning of May 14th the work had progressed sufficiently to enable 2ft. of water to be admitted at the head-gates, which reached the repaired section the same evening. Early next morning, however, a fresh slide occurred at the same place, and water was again shut off. The bottom and inside slope of the canal were then thoroughly lined with puddle about 1ft. thick for 600ft., and several hundred tons of loose rock placed under the outside toe of slope. On May 20th the head-gates were again opened, when a great diminution of seepage was noticeable over the repaired section, and no further trouble was experienced from slides. On May 25th, with a discharge of slightly over 400 cusecs at the intake, the canal was carrying 187 cusecs at Willow Creek flume, mile 14.5, with something under 100 cusecs running into the reservoir.

Following a couple of days of heavy thunderstorms in the mountains, a telephone message was received on the evening of May 31st from Cowley, some 40 miles west, that all tributaries of the Old Man River were rising at an unprecedented rate. All men and teams in the vicinity were immediately hurried to the intake, where attempts were made to rip-rap the down-stream abutment wall of the sluice gates. These were, however, of little avail owing to the rapidity with which the water rose, the darkness, and to the breaking of a heavy thunderstorm lasting most of the night. It was found impossible to close the head-gates completely owing to *débris* washed under the openings, but the canal was at this time not carrying more than half of its full supply capacity. The peak of the flood occurred about midnight, when the high-water level was about 6in. below the top of the up-stream abutment wall, the side walls of the log pass to the left of the sluice gates being completely submerged, and the counterweights of the open sluice gates being awash.

At 5 a.m. on June 1st a section of the bank just below the down-stream abutment wall slid into the canal prism, admitting the flood directly into the canal, which had filled to several feet above its full supply level. Some of this water eventually reached the Old Man flume, 4 miles away, which was overflowing for a short time, but the banks were unable to retain such an overload for long and were breached for about 400ft. in three places, at mile 1.5, mile 1.7, and mile 2, the flood tearing its way back to the river and completely washing out and overturning the concrete syphon spillway at the first breach.

As the river continued abnormally high for several days following, the gap at the head-gates was subsequently widened to some 600ft., and the water racing down the canal gradually eroded the bank from the inside for a mile and a-half, until in places very little remained. Steps were immediately taken towards the work of reconstruction, a Bucyrus two yard dragline, with a 60ft. boom being put into commission, and arriving at the intake on June 21st. It was here delayed for ten days by a further rise of the river, but eventually crossed the canal and started operations on the new bank of July 1st.

Material for the new bank is being borrowed from the old canal channel, but as it is in a saturated condition the work will have to be finished off by team work later. The top of the new bank at the intake will be 10ft. above full supply level in the canal, with a crest width of 20ft., and a slope of 2 to 1 towards the river, which will be heavily protected with loose rock.

About 700ft. of bank had been put up to the middle of July, and it was hoped at that time, that working two ten-hour shifts per day under favourable conditions this work would be completed in time to admit of water being used for autumn irrigation, about two months hence. The last breach at mile 2 had already been repaired by team work, the canal prism having been lined up to full supply level with a thick layer of puddle and the cross sectional area of the bank largely increased.

A horse-drawn elevating grader crew was then at work on the other two breaches, the material being borrowed on the high side of the canal, and hauled across three temporary timber trestle bridges over the canal by two and four yard dump wagons. The remains of the old bank there were being well levelled off and a thorough bond made between the old and new material, the base width of bank being also increased. An attempt was to be made to jack up the overturned syphon spillway, which was apparently intact with the exception of one wing wall, but if that proved impracticable it was to be destroyed by explosives, and a new one constructed in the same place.

The flume across the Old Man River, 3385ft. long and 14ft. in diameter, carried the overload to which it was subjected on the morning of June 1st without mishap; but the concrete pedestals supporting two of the steel trestles on the edge of the main channel of the river were subsequently washed out, carrying away 90ft. of the flume. It is proposed to replace the steel trestles there with a concrete pier similar to those supporting the 120ft. girders across the river, and the work of constructing a cofferdam for the excavation of the foundations has already been commenced.

The intake work, comprising the diversion weir, log-pass, sluice gates and main canal head-gates, escaped damage altogether. Designed to pass a maximum flood of 6½ft. over the weir crest, representing a discharge of 40,000 cusecs, they successfully withstood a depth of 9ft. over the crest, representing a discharge of nearly double that amount. The probable maximum flood to be reckoned with was computed from the records of the Old Man River, as kept by the Dominion Government Hydrometric staff since 1910. As all gauges and measuring stations were carried away by the present flood, an accurate estimate of the actual maximum discharge has not yet been arrived at, but from the high-water marks above and below the weir, it would appear that at least 80,000 cusecs were passed during the peak of the flood.

At the time of the break, the depth of water against the outlet gates of Keho Lake Reservoir was 10ft. As the bottom of the outlet canal is 7ft. below the lowest part of the lake, this represented an available storage capacity of 3ft. This water was used to prime the branch canal systems serving a large area at the eastern end of the district depending on the reservoir for its water supply. Water is being supplied on demand by the operating staff, but owing to the abnormal precipitation this season there have been few calls for water so far for irrigation purposes. The water has, however, been very welcome to the farmers for filling reservoirs for stock and domestic purposes, as hitherto such water has in some cases had to be hauled as far as 10 miles.

The gauge height at the outlet had fallen to 8.5ft. by July 14th, leaving only 1.5ft. water to be drawn, and it was thought that that reserve would probably be exhausted by the end of July. Every effort is, therefore, being made to complete the work of reconstruction in order that water shall be available for the autumn irrigation, which so largely determines the growth of the succeeding year's crop.

The illustrations given on page 152 and herewith are largely self explanatory, but the following particulars maybe given. Fig. 1, on that page, shows a view of the intake works taken on May 2nd, when water was being admitted to the main canal. The heaps of gravel shown in this view, and which were composed of material excavated from the weir foundations, were some of them 20ft. high. They were entirely washed away by the flood. Fig. 2 shows the water entering the Old Man River flume on May 2nd; while Fig. 3 shows the water entering the gravel section of the main canal on the same date. In Fig. 4 is seen the blowing up by explosives a weed

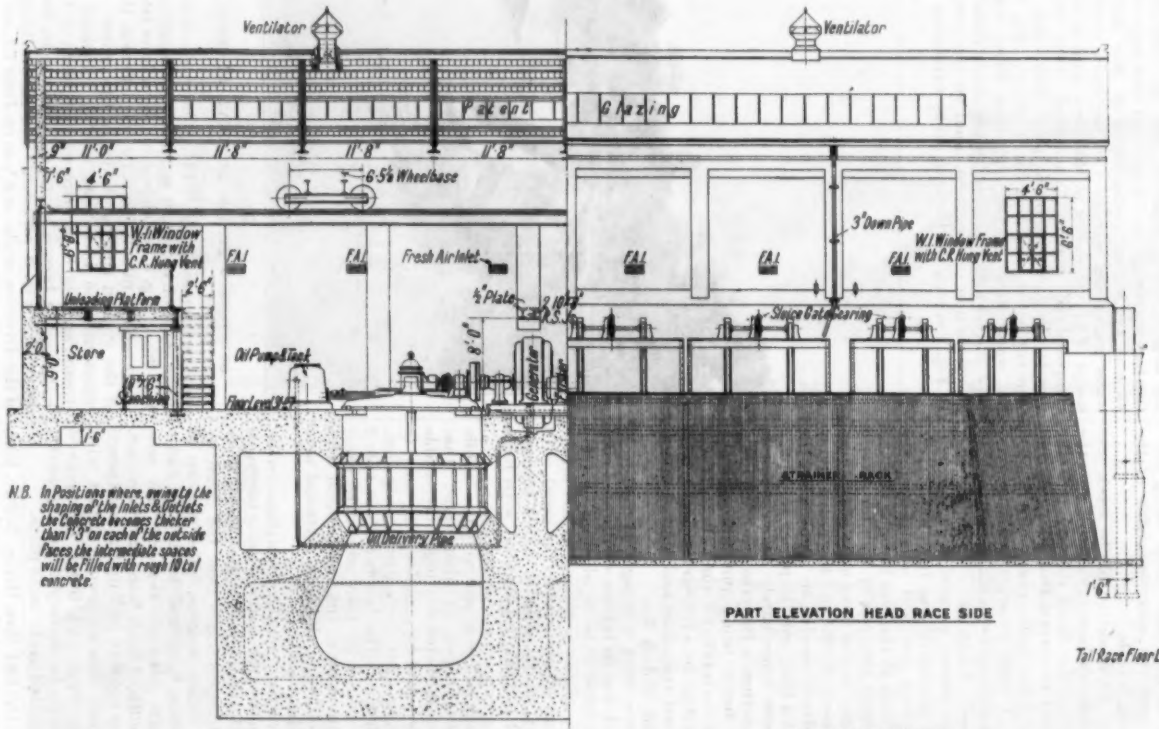
OVERTURNED SYPHON SPILLWAY AT MILE 1.5

jamb in the main canal. Fig. 5 shows the slide of the outer slope of the bank at mile 3 as it appeared on May 9th. Fig. 6, which was taken on June 1st, shows the breach at mile 1.5 looking down-stream, the ruins of the syphon spillway being in the centre. Fig. 7 represents the breach at mile 1.7 looking down-stream, and Fig. 8—also from a view taken on June 1st—shows the breach at mile 2 looking in the same direction. Fig. 9 represents the down-stream face of the diversion works as it was on June 1st, and shows the breach in the bank, while the up-stream face of the diversion work is shown in Fig. 10. In connection with Fig. 11, which is a view taken on June 6th, of the breach at the head-gates looking down-stream it may be explained that the peak of the flood was 6in. below the top of the retaining wall in the left foreground. Fig. 12, which is reproduced from a photograph taken on June 8th, shows the breach at the head-gates looking up-stream.

* No. I. appeared August 3rd.

LINTON LOCK HYDRO-ELECTRIC POWER HOUSE FOR THE CITY OF YORK

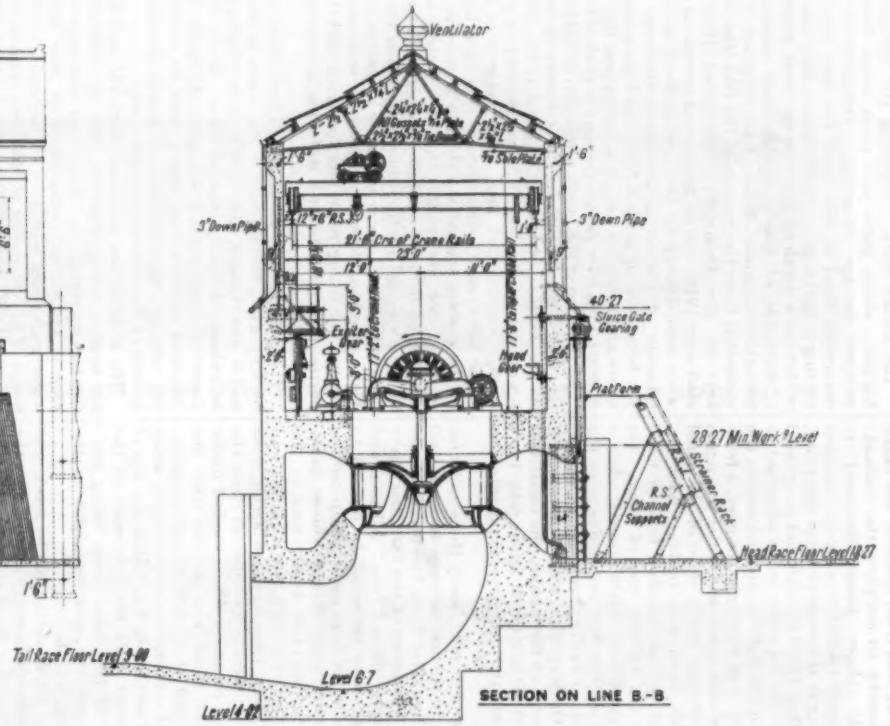
(For description see opposite page)



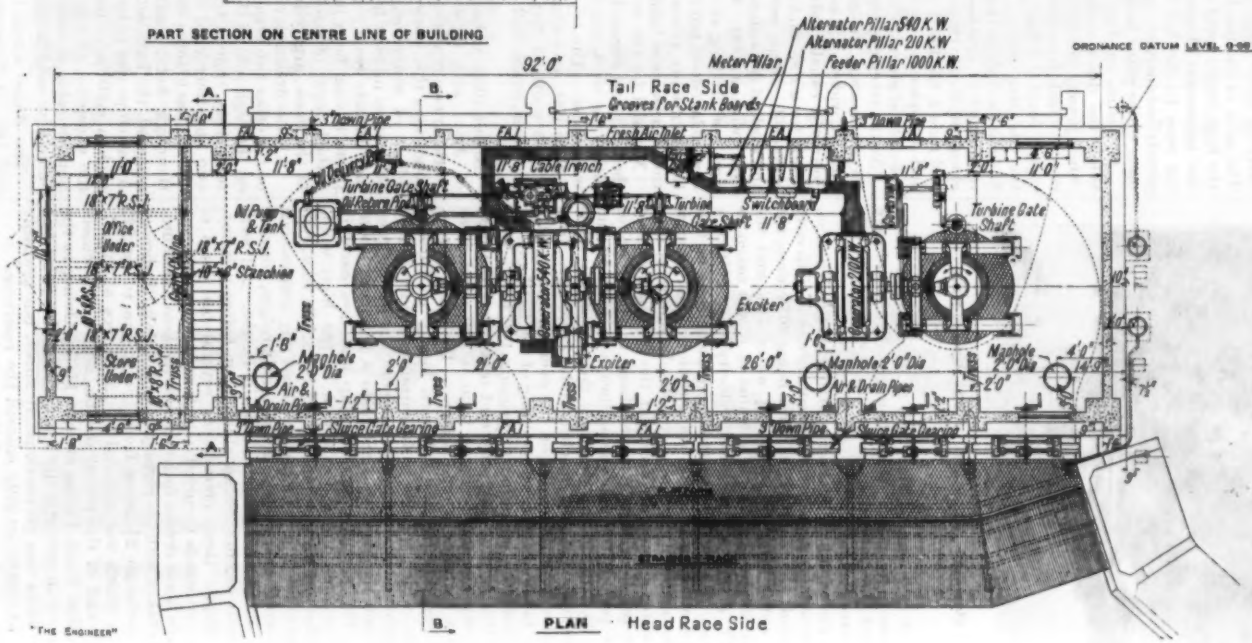
PART ELEVATION HEAD RACE SIDE

PART SECTION ON CENTRE LINE OF BUILDING

N.B. In Positions where, owing to the shaping of the Inlets & Outlets the Concrete becomes Thicker than 1'-3" on each of the outside Faces the intermediate spaces will be Filled with rough Rubble concrete.

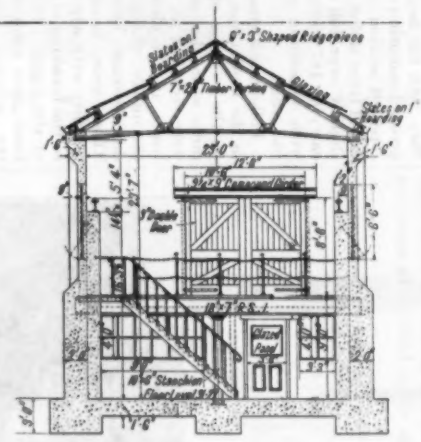


SECTION ON LINE B.-B



PLAN Head Race Side

ORDNANCE DATUM LEVEL 0·00



SECTION ON LINE A.-A.

"THE ENGINEER"

The City of York Hydro-electric Power Station.

When it became necessary to consider the best method of meeting the increasing demand for electricity in the city of York, the advisability of erecting a hydro power station was carefully looked into, and it was finally decided to build a station on the river Ouse at Linton Lock, which is about 11½ miles from the city. In common with most other rivers without natural compensation, the Ouse has a very variable discharge. Roughly, it varies from 50,000 cubic feet per minute in the dry periods to 200,000 cubic feet in the wet months and taking 100,000 cubic feet per minute as the average, with 8.83ft. head, the estimated output of the proposed station was 1200 horse-power. Calculations showed that the available energy in years of normal rainfall would exceed 2,750,000 kilowatt-hours per annum.

The scheme having been shown to be sound, the York Corporation decided to proceed with it, and in order to concentrate supervision and responsibility and to make the co-ordination of the various parts of the work easier, it was deemed advisable to include the civil engineering work, the building work, and the supply of plant in one comprehensive contract, which was eventually awarded to the English Electric Company, Limited. On Wednesday, August 1st, the Linton Lock hydro-electric power station, which is situated on an island, was opened by Princess Mary, Viscountess Lascelles, and Viscount Lascelles.

The nearest railway station to the site of the new power station is about four miles distant, and there is no carriage-way from the nearest main road, about half a mile away. It was necessary, too, to bridge the old lock at Linton to get material on to the island. Below the water level the site proved to consist of very soft silt, and much difficulty was experienced in getting foundations down below the river months ago being the highest experienced for twenty-three years.

FIG. 1—VIEW OF HYDRO-ELECTRIC POWER HOUSE AT LINTON LOCK

The power-house, which is shown in Fig. 1, is carried on 110 ferro-concrete piles which extend down to the requisite depth. Cofferdams, both of timber and steel, had to be constructed and much pumping also had to be carried out. The work was also handicapped by high floods one which occurred a few months ago being the highest experienced for twenty-three years.

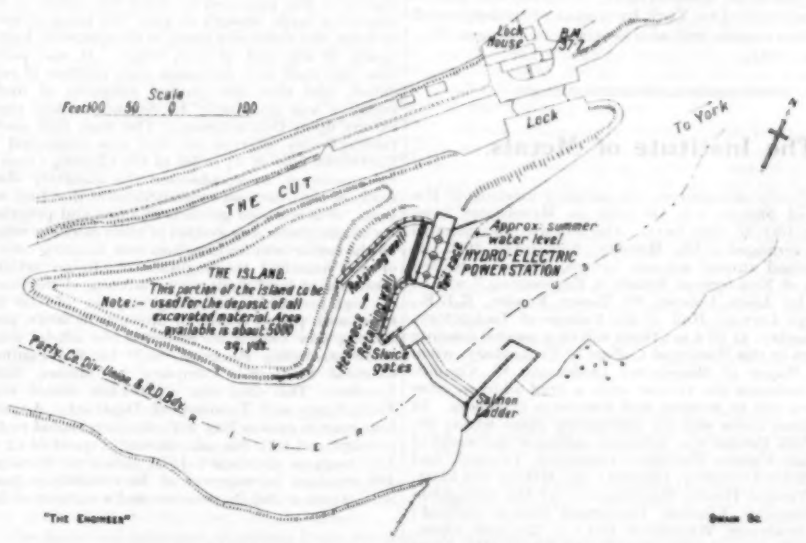

Lock House
Lock
To York
THE CUT
Approx. summer water level
HYDRO-ELECTRIC POWER STATION
THE ISLAND.
Note:- This portion of the island to be used for the deposit of all excavated material. Area available is about 5000 sq. yds.
Sluice gates
Salmon ladder
Party Co. Div. Union & R.D. Bdy.
"THE ENGINEER"

FIG. 2—PLAN SHOWING POSITION OF POWER HOUSE

to 60ft. or 70ft. below the normal ground level. The power-house building is of reinforced concrete, and as the construction of the foundations of the walls to the head and tail races involved some difficulty on account of the running silt, they were also constructed of reinforced concrete. Because of the danger of the water in the head-race finding its way below the power-house through the soft silt, it was necessary to take many precautionary measures to ensure that no leaks could take place. Considerable care had also to be exercised in connection with the foundations on account of the nearness of the lock to the works. Had the river broken through the temporary works it would have quickly washed out the silt and have done great damage along the river both above and below the site.

As the existing weir across the river was built about one hundred years ago, and as no drawings were available showing the details of construction below the water level, it was necessary to carry out the work in the vicinity of the dam with great caution. As will be seen from Fig. 2, the water is led to the forebay by means of this weir, but a set of automatic shutters, as shown in Fig. 5, have been constructed in order to keep the river at the desired level. In times of flood these shutters fall, thus enabling the water to pass, and as the river regains its normal flow the shutters automatically rise and retain the water at the correct level. The shutters are controlled by counterweights made of pumice stone concrete of the correct specific gravity for the conditions under which they operate. This arrangement does not interfere with the operation of the existing fish pass at the right bank of the weir.

After entering the head-race or forebay the water, on its way to the power-house, passes through strainer racks and main sluice gates and then to three turbines. Two of these turbines are each capable of developing 430 horse-power at a speed of 60 revolutions per minute, and they drive a generator rated at 540 kilowatts. The third turbine is a smaller machine, rated at 330 horse-power at a speed of 75 revolutions per minute, and it drives a 210-kilowatt generator.

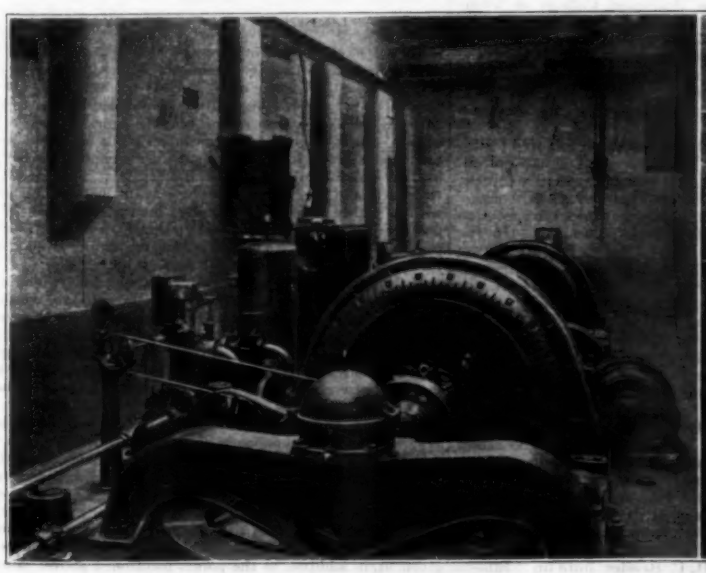


FIG. 3—INTERIOR OF POWER HOUSE

FIG. 4—TURBINE GATE MECHANISM

The power station works on an average with an hydraulic efficiency of 75 to 85 per cent., according to the available heads, and will generate in years of normal rainfall about 2,780,000 kilowatt-hours per annum. The small turbine has been designed to deal economically with small loads. Its specific speed has been chosen to give a high efficiency over a wide range of partial loads, and will therefore enable the power station to work efficiently even when small quantities of water are coming down the river. The water passes to the gate apparatus of the turbine inside the power-house through concrete spirals. These spirals lead the water to the gate apparatus in a better manner than ordinary pits, and in consequence of a higher water velocity they save space. The arrangement also allows the turbines to be situated higher than would

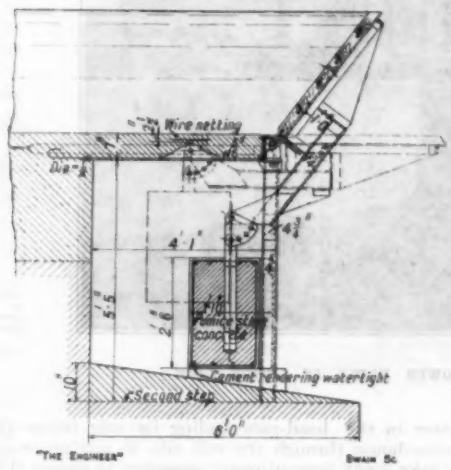


FIG. 5—AUTOMATIC WEIR SHUTTERS

otherwise be permissible, and a good exit for the draught tube is obtained without undue excavation, even where the fall is small. At the same time the floor level can be raised to any convenient height, and in the present case it has been made to correspond with the average water level in the forebay, with a view to reducing the necessary volume of concrete. In times of flood it is below the up-stream level.

With a view to subdividing the total capacity of the station into units which would give the highest efficiency, a thorough study was made of the conditions under which the station would operate. With turbines working under low heads the efficiency falls rapidly when they are working below 50 per cent. of their rated full load, and in order to obtain the best results it is necessary that the units in operation shall

FIG. 6—THE MAIN SWITCHBOARD

as far as possible run above that point. When only small quantities of water are available it is most economical to use a turbine of low output, but it is essential to remember that the larger the units the higher will be their efficiency and the lower the first cost of the station. The largest Francis type runner used at the station has an exit diameter of 10ft. and weighs about 5¼ tons. It can absorb 33,000 cubic feet of water per minute under a head of 8.83ft. and has a specific speed of 81 in British units. The blades are composed of thin sheet steel in order to give a large passage for the water, and each blade was ground and polished before being cast into the rings. The edges of the blades are also chamfered in order to reduce the losses due to shock at the entrance.

Each gate apparatus—see Fig. 4—consists of twenty guide vanes, 43.3in. high in the case of the large turbines and 35.5in. high in the case of the small turbine. These vanes are composed of cast iron and are pivoted at their ends in bronze bushes carried by the foundation rings, and they are operated from above by means of levers and linkwork. The massive cast iron foundation rings are connected by steel pillars and are built into the concrete. The weight of the runners in the case of the large turbine, which has an exit diameter of 10ft., is over 5½ tons. From the vertical shafts of the turbines the power is transmitted to the generator by means of machine-cut double gearing, and flexible couplings are interposed between the horizontal gear shaft and the generator. The speed of the sets is controlled by automatic oil pressure governors, which have been adopted because they are considered to be more sensitive and reliable than other types. The head and tail-races are connected to a water level recorder in the power-house and traces on a chart the head under which the turbines are working. The full-load efficiency of the generators is about 94 per cent., and, taking 80 per cent. as the average efficiency for the turbines and allowing 2 per cent. loss in the bevel gears, the overall efficiency of the power station is about 74 per cent. An interior view of the power-house is given in Fig. 3, and a drawing showing the general arrangement of the plant is given on page 148.

The switchgear—see Fig. 6—for controlling two of the generators and one of the feeders is of the English Electric Company's cast iron draw out pillar type, and all the live parts are completely enclosed and are fully interlocked in order to make them fool-proof. The generators are protected by three over-load coils and a reverse power relay operating through an auxiliary relay on a low-voltage trip coil energised by the individual exciters of the machines, whilst the feeders are protected by simple overload coils. The feeder switches are fitted with buffer resistances and charging contacts. A special earthing switch is also provided for earthing the cables. A similar pillar, but of the non-draw-out type, carries the synchronising gear and potential transformers. The electric power will be transmitted to York by means of underground cables, and a supply will also be given to villages, &c., along the route.

The Institute of Metals.

As previously announced, the autumn meeting of the Institute of Metals will be held in Manchester from September 10th to 13th next. The following programme has been arranged:—On Monday, September 10th, at 8 p.m., second annual autumn lecture, which is entitled "The Use of Non-ferrous Metals in Engineering," will be delivered by Lieut.-Colonel Sir Henry Fowler, K.B.E., in the large Lecture Hall of the College of Technology. On the Tuesday, at 10 a.m., there will be a general meeting of members in the Municipal College of Technology, when the Lord Mayor of Manchester (Alderman W. Cundiff, J.P.) will welcome the visitors with a brief address, after which there will be reading and discussion of papers. In the afternoon there will be alternative visits to (*a*) the Trafford Park Estates Co., Limited, calling at the works of Metropolitan-Vickers Electrical Company, Limited, and the Ford Motor Company, Limited; (*b*) Mather and Platt, Limited, Newton Heath, Manchester; (*c*) the Broughton Copper Company, Limited, Broughton Bridge, Salford; and (*d*) Armstrong, Whitworth and Co., Limited, Openshaw, Manchester. In the evening, at 8 p.m., the party will attend the ceremony of the formal opening of the new building of the Department of Metallurgy, and at 9 p.m. there will be a reception by the Vice-Chancellor of the University, Professor Sir Henry Miers, F.R.S., in the Whitworth Hall of the University.

On the Wednesday, at 10 a.m., there will be a general meeting of members at the Municipal College of Technology for the reception and discussion of papers. In the afternoon a trip will be made along the Ship Canal at the invitation of the Ship Canal Company. Alternatively, for those who may prefer it, motor conveyances will take members to visit a cotton mill in the district.

On the Thursday, at 9.30 a.m., the party will start on a visit to Chester.

The following communications are expected to be submitted for discussion at the meeting:—(1) E. A. Bolton, "The Cause of Red Stains on Sheet Brass;" (2) Dr. H. W. Brownsdon, note on "Brinell Hardness Numbers;" (3) H. I. Coe, "The Behaviour of Metals under Compressive Stresses;" (4) Hikozô Endo (Sendai, Japan), "On the Measurement of the Change of Volume in Metals during Solidification;" (5) Ulick R. Evans, "The Electrochemical Character of Corrosion;" (6) Marie L. V. Gayler, "The Constitution and Age-hardening of the Quarternary Alloys of Aluminium, Copper, Magnesium, and Magnesium Silicide;" (7) Dr. D. Hanson, D.Sc., C. Maryatt, B.Sc., and Grace W. Ford, B.Sc. (Teddington), "Investigation of the Effects of Impurities on Copper: Part I., The Effect of Oxygen on Copper;" (8) Douglas H. Ingall, "Experiments with some Copper Wire: Cohesion a Function of both Temperature and Cold Work;" (9) A. H. Mundey and C. C. Bissett, note on "The Effect of Small Quantities of Nickel upon High-grade Bearing Metal;" (10) A. H. Mundey and John Cartland, "Stereotyping;" (11) Hugh O'Neill, "Hardness Tests on Crystals of Aluminium;" (12) Albert M. Portevin (Paris) and Pierre Chevenard (Imphy), "A Dilatometric Study of the Transformations and Thermal Treatment of Light Alloys of Aluminium;" (13) Dr. R. C. Reader, note on "Effects of Rate of Cooling on the Density and Composition of Metals and Alloys;" (14) E. L. Rhead and J. D. Hannah, "Crystallisation Effect on Galvanised Iron Sheets;" (15) Professor P. Soldau (Petrograd, Russia), "Equilibrium in the System Gold-zinc (based on Investigations of Electrical Conductivity at High Temperatures)."

Sixty Years Ago.

SIXTY years ago railway communication within the Metropolis was still in its infancy, and such questions as the rival merits of underground and overhead systems and improvement of the then existing railways were eagerly debated. In this respect our leading article of August 7th, 1863, proves interesting reading. A Parliamentary Committee appointed the previous session to consider the problem of railway communication in London reported its unqualified approval of the superiority of underground railways as compared with those at or above the street level. This opinion was supported by the success of the 3¾ miles of Metropolitan Railway which, at the time of which we are writing, had average receipts of some £2000 weekly, without apparently creating any diminution in the takings of the London Omnibus Company, which were then from £12,000 to £13,000 per week. Basing our estimate on a population of 2,800,000, of which, say, 500,000 were in a position to pay 2s. per week for conveyance from one part of the City to another, we calculated that with a comprehensive system of metropolitan railways, a weekly traffic of £40,000 might be secured without entirely extinguishing the cab and omnibus traffic. Under the parliamentary report referred to, it was expected that schemes involving 30 to 40 miles of railway, with an expenditure of £35,000,000 capital, would be presented for parliamentary sanction. It was apparently resolved to have a railway wherever there was an omnibus route. So great was our confidence in underground railways that we predicted similar schemes would be put forward in the continental capitals and also at New York. In another part of our article, improvements to the then existing underground line between Farringdon-street and Paddington are discussed. The smoking, reeking locomotives of that line were unhesitatingly condemned. Attention was drawn to the success of the 33in. pneumatic dispatch tube erected between Eversholt-street and Euston, and to the proposed 54in. tube for the General Post Office, and it was suggested that further mechanical improvements might bring this mode of conveyance into successful competition with steam locomotion. Another alternative mentioned was the "hot water" or "fireless" locomotive, upon which some experiments had been made by Mr. Fowler. In this engine it was proposed to store the steam in hot water reservoirs large enough to give 100 horse-power for half an hour, the reservoirs being re charged with high-pressure steam at the end of each stage. It was pointed out, however, that such questions were matters of engineering detail, and that the general adoption of underground railways was not likely to depend to any considerable extent upon this solution. The high first cost of such railways was referred to, and was compared with the £3,000,000 cost of 2¼ miles of the Charing Cross Railway. In conclusion, we emphasised the unsightly character of many of the overhead constructions of that line, and stated that "if it were on grounds of taste and propriety alone, we should prefer any system of town railways which spared us the boiler-iron architecture now looming over so many of our principal thoroughfares." In an article on the economy of land engines, we advocated the construction of high-pressure condensing engines of the horizontal type, with piston speeds of upwards of 500ft. per minute. Among new vessels we recorded the official trials of the screw steamship Rangoon, built for the Peninsular and Oriental Steamship Company by Messrs. Samuda, of London. This ship was a 2014-ton vessel, engined by Humphreys and Tennant, of Deptford. An average of four runs in Stokes Bay with the ship loaded to 17ft. 11in. forward and 18ft. 9in. aft, showed a speed of 12·46 knots. The engines developed 1870 indicated horse-power, or 400 nominal horse-power at 66 revolutions per minute, with steam at 26¾ lb. pressure and a vacuum of 25½in.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

LOSSES IN REDUCTION GEARS.

SIR,—I have noticed in several technical papers lately that some gear makers are advertising complete reduction gear units with an overall efficiency of 98 and 98¼ per cent., which I consider to be very misleading. If this is intended to refer to losses between teeth only, then I agree that the figure is possible, and, in fact, can be slightly improved upon; but in considering a reducing gear unit as a whole, there are many points to be taken into account affecting the overall efficiency. First of all, the friction loss of four or five bearings, as in the case of a pinion with a centre bearing; secondly, resistance caused by the passage of the oil through the teeth; thirdly, windage; fourthly, power required to drive oil pump, &c., for a lubricating system, particularly in the case of forced lubrication.

If the gear is one of a moderately low speed not requiring an oil pump, the losses due to this latter item would, of course, be omitted, but there would be additional friction in actually dipping the gear wheel teeth in the oil in the bath.

Most gear makers appear to be working on the assumption that efficiency is practically constant for all loads and speeds for different gear ratios; but this is not strictly correct, although the discrepancy is not very large.

From my card, which I enclose, you will see that I have had a very considerable experience of this subject, and I can confidently say no reduction gear of any type, including all the friction points mentioned above, from the incoming coupling and the outgoing coupling, will give anything like 98 per cent. overall efficiency.

Every proposition has to be taken on its merits before an absolute guarantee that will satisfy a turbine builder can be given, as, in addition to the points mentioned above, ratio has got a considerable bearing on the subject.

There has been undoubtedly an enormous amount of guesswork, and if gear users would test some of the gears which are specified for 98¼ per cent. efficiency, they would find that they were being misled by random statements.

August 6th. M.I.M.E.

Railway Matters.

We regret to hear of the death on the 27th ult. of Mr. G. H. Burrows, the chief draughtsman at Swindon and personal assistant to the Great Western chief mechanical engineer.

The Bill for the acquisition by the Great Western Railway Company of the property of the Swansea Harbour Trustees has received the Royal Assent and the transfer has been made as from July 1st.

The Railway Fires Act (1905) Amendment Bill—mentioned in this column on April 13th—and the Railways (Authorisation of Works) Bill—described herein in the issue of July 20th—were amongst those which received the Royal Assent before Parliament adjourned.

In pre-war days some of the smaller railway companies used to issue "go as you please" season tickets, whereby visitors could for a period go to and fro within a certain radius. This practice has now been revived by the Southern Railway between the stations in the Isle of Wight.

One of the difficulties that prevent an agreement being arrived at for the absorption by the Southern Railway of the Freshwater, Yarmouth and Newport Railway is that a tunnel may be constructed under the Solent, and this railway become an important factor in the defence of the southern coast.

Answering a question on the 2nd inst., Colonel Wilfred Ashley said: "The Government have decided to introduce a Bill on the subject of London traffic in the autumn. The Bill will follow the general lines of the suggestions made to the Royal Commission on London Government in the evidence given on behalf of the Ministry of Transport."

The new grouping arrangements of the companies had the effect of taking rolling-stock, not hitherto familiar, into some holiday resorts last week-end. At Llandudno, for instance, former Midland and North Staffordshire coaches were seen in plenty. It is said, too, that new territories are being served, and that there is a greater long-distance traffic.

The Engineer-in-Chief on the Railway Board, Simla, who was deputed some time ago to draw up a scheme for new railways to develop the area served by the South Indian Railway, has, says the *Indian and Eastern Engineer*, recommended the doubling of the metre gauge line from Madras to Villupuram, the new metre gauge chord railway from Villupuram to Trichinopoly on the double standard gauge sub-grade basis, the new metre gauge chord line from Trichinopoly, *viâ* Karaikudi and Mannargudi, to Manyachi on the single standard gauge sub-grade basis, as far as Karaikudi, and the Arantangi-Karaikudi metre gauge extension.

On June 6th a passenger train entering Walsall Station was derailed. The circumstances were inquired into by Major Hall, whose report thereon was issued on the 31st ult. The accident was due, it seems, to a calling-on signal, lowered for the previous train, having failed to go to the "danger" position when its lever was actuated by the signalman. This man omitted to notice the irregularity, and, being unable to see the lines, he changed some facing points whilst the second train, in response to the signal, was entering the station. The failure was due, it was thought, to the nut on the end of the balance lever of the signal catching on the wire of another signal.

In the debate on unemployment initiated by Mr. Lansbury on the third reading of the Consolidated Fund Bill on the 1st inst., Sir Montague Barlow spoke of the benefit the Trade Facilities Act had been in helping railways with schemes that gave relief for unemployment. He hoped the Electricity Commissioners would press on the work of electrical development, and the railway companies, who were now possessed of reserve funds running to £130,000,000, compared with one-quarter of that amount before the war, could render very ready help to the community if they would utilise their very large reserves for necessary reconditioning and also for electrical development.

According to the Board of Trade returns, the value of the railway material exported during the six months ended June 30th last was as follows, the corresponding figures for 1922 and 1921 being added in brackets:—Locomotives, £1,571,021 (£2,992,504, £3,459,385); rails, £1,193,792 (£1,525,330, £1,793,057); carriages, £589,292 (£860,791, £815,260); wagons, £1,521,657 (£2,033,145, £3,057,041); wheels and axles, £511,434 (£746,387, £1,115,857); tires and axles, £261,324 (£239,973, £806,886); chairs and metal sleepers, £491,811 (£1,224,924, £735,862); miscellaneous permanent way, £572,544 (£824,512, £1,467,742); total permanent way, £3,182,699 (£4,670,121, £6,070,950). The weight of the rails exported was 133,798 tons (147,332 tons, 81,319 tons) and of the chairs and metal sleepers, 44,154 tons (88,805 tons, 29,656 tons). During June, 1923, locomotives to the value of £159,563 were shipped to India and rails to the value of £65,265 to British West Africa and of £29,045 to India.

The four railway groups have now submitted to the Railway Rates Tribunal the schedule of standard rates and charges demanded from them under the Railways Act, 1921. Under the Act, these should have been presented by December 31st last year, but the date of presentation has twice been extended by the Minister of Transport, first to June 30th and later to July 31st. The schedule of charges, as approved by the Railway Rates Tribunal, will form the basis on which the standard revenue of the railway groups will be raised. Under the Railways Act the charges of the companies are to be limited to such as will, together with the other sources of revenue, yield, with efficient and economical working and management, an annual net revenue equivalent to that received in 1913. There is, however, provision made for a suitable allowance under various heads in respect of capital expenditure since 1913, and capital expenditure not fully remunerative in 1913. The standard charges on this basis will be subject to review by the Railway Rates Tribunal every twelve months. Objections to the proposed rates must be lodged by about the middle of October—the date will be announced later—and they will be considered by the Tribunal.

Notes and Memoranda.

In replying to some questions after a lecture on stainless steels before the Coventry Engineering Society, Dr. W. H. Hatfield said that that material could be brazed, soldered and welded by electrical methods, but not with the acetylene blow-pipe or ordinary processes.

During the year 1922 Canada's production of gold, as reported by the Bureau of Statistics, amounted to 1,263,364 fine ounces, valued at 26,116,050 dollars, an increase of 36 per cent. above the previous year. This production has only been exceeded once, in 1900, when 1,350,057 oz., valued at 27,908,153 dollars, were produced. In that year the Yukon placers reached the peak of their production.

A prolific cause of accidents in overhead line work is the falling of tools or other small objects that are being raised by means of hand lines. To prevent such accidents, the Philadelphia Electric Company uses a wooden-bottom canvas bucket for the hoisting of all small tools and materials. Experiments are also being conducted with an inverted conical tent around the pole to catch falling articles and prevent injury to workmen or passers-by.

At a meeting of the Board of Directors of the Manchester Chamber of Commerce on July 16th, resolutions were passed urging traders to use the litre and kilogramme in preference to the gallon and ton, which are capable of varying interpretations. A resolution on somewhat similar lines was passed at a recent meeting of the Association of British Chambers of Commerce. This resolution mentioned the difference existing between the American and Imperial gallons, and urged that "all trades, especially those engaged in overseas trade, should employ some universally accepted measure, such as the litre."

The major portion of the world's supply of cobalt for almost two decades has been derived from the silver-cobalt-nickel arsenides of the cobalt district of Ontario. The cobalt residues from the cyanide process were mainly treated in Canada during 1922, although some of them, as well as smelter residues, amounting in all to 518 tons, containing 173,211 lb. of cobalt, were shipped abroad for treatment. The cobalt production of Canada in 1922 was 569,960 lb., which at 3.25 dollars per pound would be worth 1,852,370 dollars. These figures, compiled by the Bureau of Statistics, were obtained as the total of the metal cobalt contained in smelter products made in 1922, and cobalt in residue exported for treatment valued at 3.25 dollars, which was the average New York quotation for cobalt during the year.

Three automatic re-closing circuit breakers have been in service for three years at a sub-station of a steel company in Pennsylvania without requiring any repair expense. During this period the only trouble has been a slight corrosion on the contacts of the re-closing solenoid, which was very easily remedied. These 250-volt breakers are installed in a motor generator sub-station and provide protection to various feeder circuits. Two of the breakers, rated at 5000 ampères, are used on a generator circuit and a feeder circuit belonging to a 400ft. double trolley gantry crane in the coal storage plant. The other breaker, having a capacity of 2000 ampères, is placed on a feeder circuit belonging to another part of the plant. The switch duty has not been severe, since under the worst conditions the breakers have not opened more than three to four times a week.

In the course of a paper on the effect of resting pauses on the efficiency of manual workers, read before the British Psychological Society, Mr. G. H. Miles said that tin-plate workers in an eight-hour plant took 12 min. to 14 min. in the hour, whereas in a six-hour plant the time taken was 15 min. Puddlers, on the other hand, followed 20 min. work by 20 min. rest. Though such spontaneous rests, however, may be agreeable to the individual, they do not make for efficient working of the group. If instead of taking spontaneous pauses which may be distracting to other workers, the worker can be given the necessary relief in an organised pause, in which the whole group partakes, the mass effect of all intensely working together will be operative and, in addition, the relaxation during the rest periods will be more complete.

In the course of a paper read before a recent meeting of the American Institute of Mining and Metallurgical Engineers, Mr. N. B. Pilling stated that practical limitations to the usefulness of silicon steels are the hardness and brittleness which silicon imparts to iron, making iron-silicon alloys of more than 8 per cent. silicon content unusable except where castings can be employed. Commercial silicon steel becomes brittle when the silicon content exceeds 4.2 per cent. Temporary ductility may be obtained by carrying on cutting or deformational operations at temperatures slightly above atmospheric, the temperature depending on the steel composition. Brittleness is modified only slightly by heat treatment. The purest iron shows a similar brittleness at about — 30 deg. Cent. The effect of certain alloying elements is that silicon and aluminium raise the critical ductility temperature, and manganese lowers the critical ductility temperature.

According to the *Electrician*, the Allgemeine Elektrizitäts Gesellschaft have recently manufactured a high-tension direct-current machine for the experimental station of the Gesellschaft für drahtlose Telegraphie at Geltow. The machine has a continuous capacity of 30 kilowatts at 1100 revolutions per minute and works at a pressure of 4000 volts. It is a four-pole auxiliary pole machine without any compensation windings. The armature has two separate windings and two commutators, the latter being connected in series. Both armature windings are held in slots which are highly insulated in order to cut down surging as much as possible. The commutator segments are separated by very thick mica sheets. Two small carbon brushes collect the current, and are staggered so that if any tendency to arc arises the distance between the opposite poles is the maximum possible. Another interesting point is the wide insulating sparking surface between the commutator segments and the commutator core. The machine is separately excited from a 220-volt circuit by the alteration of which the voltage can be reduced to 2000 volts.

Miscellanea.

After being idle for several years, the old copper works at Burry Port have been partially restarted.

A cement manufacturing company is in course of organisation in Liaoyang, Fengtien, China. The material for manufacture will be obtained from Penlashantze. The capital of the company is some £100,000.

The largest saw-mill on Vancouver Island, with a daily capacity of 450,000ft. on an eight-hour shift, is to be constructed, according to *Canada*, in the Bear Lake district of Cowichan Lake. The Chemainus mill is now the largest on the island, with a cut of 500,000ft. in a ten-hour day.

A large tract of land at Elton, Sandbach, formerly included in the estate of the Marquis of Crewe, has been purchased by the British Soda Company. Shafts have been sunk, and works are in course of erection for the making of salt, soda, &c. Not a quarter of a mile away another firm has sunk a brine shaft.

The Peking Technical College has organised an Institute of Industrial Research. The Institute's work is collecting and classifying products from all over China, both raw and manufactured, and investigating and comparing the nature and quality of material, with a view to devising means for improvement or to extending its use.

Under the auspices of the Honan provincial authorities in China a modern highway between Kaifeng, Honan and Tungkwang, Shensi, is being planned. A party of officers has been despatched by the Honan military authorities to survey the different sections of the projected highway. A movement for the construction of a modern highway between Kweilin and Mongkiang, Kiangsi, has received the support of the different classes of people in that province. A temporary office has been established to make preparations for the work.

The production of pig iron in Canada during June declined slightly from the high record of the previous month, the output being 99,239 gross tons, compared with 101,533 tons in May. Seven furnaces were in operation at the end of the month, three at Sydney having been banked. The production of steel declined to 96,167 tons in June from the record of 104,079 tons for May. The cumulative production of steel for the half-year ended June 30th was 476,430 tons, compared with an output of 177,080 tons in the corresponding period of 1922.

It is understood that a conference will be held between the representatives of the Travancore Durbar and the Revenue and the Irrigation Members of the Madras Government regarding the project elaborated by the Durbar in consultation with certain English engineering firms for harnessing the Kallar River, which has its source in the Travancore territory and passes through the Madura district. The Durbar's idea is to have electric works on the British side, where the fall is greater, and convey the power generated there to Travancore to be utilised for industrial and lighting purposes. The discussion will be for the purpose of making mutual adjustments of rights between the two Governments, and fixing the compensation to be paid by the one party to the other for putting the scheme through.

The Italian engineer, Commendatore Luigi Luiggi, who was recently invited by the Egyptian Government to inspect the ports of Alexandria and Suez, has now submitted a report in which he recommends various improvements at both. He divides the work proposed into three categories according to urgency. In the first place, he advises the early construction of wharves at some distance from each of the two towns, for the loading and unloading of oil, petrol, benzine, &c. In the second category he advises the building of new quays in order that adequate accommodation may be provided for the shipping visiting the two ports. In the third category he proposes the construction of depôts and reservoirs for petrol, benzine and coal and various other improvements. He estimates the cost of the whole scheme at £E1,700,000 for Alexandria and £E850,000 for Suez, the expenditure to be spread over the seven years which the work would require for its execution.

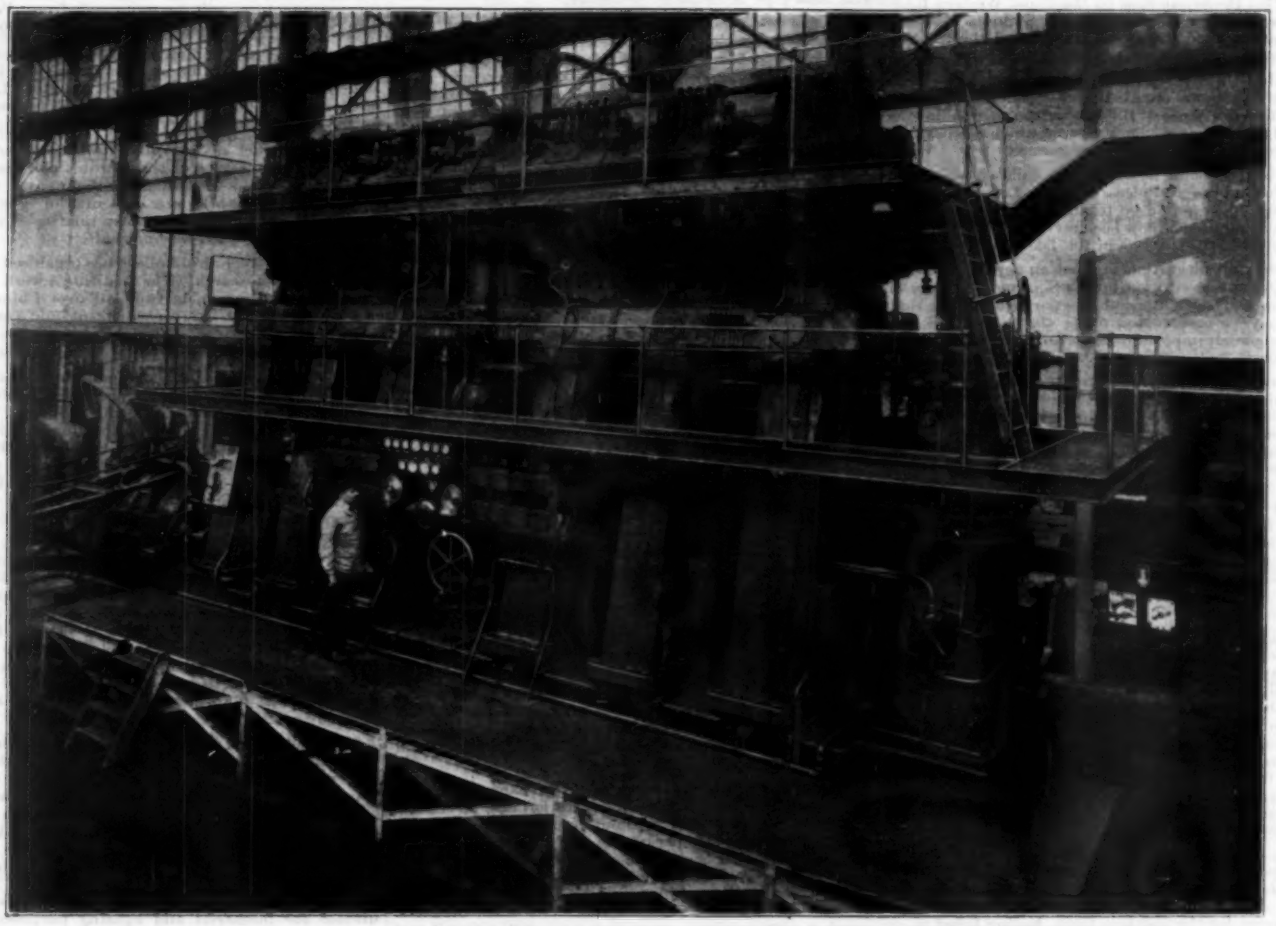
We regret to see in the American papers recently to hand the death, on July 11th, at the age of eighty-five years, of Mr. R. W. Hunt, the well-known metallurgist. Mr. Hunt was President of the American Institute of Mining Engineers in 1883, and again in 1906. He was President of the American Society of Mechanical Engineers in 1891, of the Western Society of Engineers in 1893, of the American Society for Testing Material in 1912, and in 1914 American vice-president of the International Association for Testing Materials. He was awarded the John Fritz medal in 1912 for his contributions to the early development of the Bessemer process, and only as recently as June 17th last was the recipient of the Washington award which is presented annually by the Western Society of Engineers acting jointly with the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining and Metallurgical Engineers, and the American Institute of Electrical Engineers.

A message from Kashgar dated June 20th announces the completion of the Marconi wireless station at that place. A contract between the Chinese Government and the Marconi Wireless Telegraph Company for the erection of three stations at Lanchowfu, Urumchi and Kashgar, linking up with Peking, was concluded in 1919. Later, it was decided that the first station should be erected at Urca instead of Lanchowfu. The second station, situated at Urumchi, was finished last year, and now the third at Kashgar has been successfully completed. There being no proper roads across the continent, the apparatus had to be packed so that it could be transported by camel, and it is interesting to note that the enormous amount of material, including such heavy baggage as cement, has been transported without serious loss or inconvenience. The work has been carried out by Major S. T. Dockray, to whose pluck and determination and skill the erection of the three stations is a striking tribute. Major Dockray will proceed to India and thence to England, returning to Peking later this year.

1500-B.H.P. MARINE DIESEL ENGINES

SCHNEIDER ET COMPAGNIE, LE CREUSOT AND LE HAVRE, ENGINEERS

(*For description see page 157*)



ENGINE FOR A CARGO BOAT

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THE ENGINEER.

AUGUST 10, 1923.

The Economic Use of Wood.

It is a curious truth and one which, rightly regarded, we need not feel humiliated in confessing, that, in spite of all the advances made in metallurgy, in spite of all our just pride in iron and steel, there is still no material more wonderful than wood and none which, from the point of view of variety of use, is more valuable. As a structural material we must not estimate its importance by the limited extent to which it is employed in modern engineering. If we may judge from the fact that in a recent year the value of our timber imports was nearly three times as great as that of the iron ore imported or raised in the country, it would seem that, house building, furniture making, and the other constructive industries being included, the amount of wood used for structural purposes still exceeds the volume of iron and steel. Next in importance to its employment structurally is its use for the manufacture of paper. In this respect it is to-day easily the dominant material, its volume far exceeding that of rags, esparto and other substances used in papermaking, and, including wood fibre wall boards, at least equalling the amount of straw used in the production of cardboard. As a direct fuel its importance, at any rate in this country, may be classed as negligible, and even in the form of charcoal the amount absorbed is not of much consequence. Nevertheless, as a rival to coal it finds a third important outlet in the processes for its destructive distillation which have been evolved during the past seventy years, processes which yield a series of valuable substances similar to and almost as extensive as those derived from the destructive distillation of coal. The uses to which wood is put thus render it in turn an alternative to iron and steel, flax and other grasses, and coal. Lacking these substances, civilisation, with sufficient wood at its command, could still have reached a high degree of evolution. When we reflect further that, whereas our stocks of iron ore and coal are definitely limited, it is certainly within our power constantly to renew our sources of timber, we can hardly escape the thought that wood was meant by Nature to be our principal material, and that iron and coal were placed at our disposal as conveniences rather than as necessities. Are we, then, making the best possible economic use of our timber resources? Or are we both wasting our wood and at the same time prodigally exhausting the definitely limited supplies of coal and iron which have been made available to us?

From the point of view of natural economics, engineers, as the chief users of iron and steel, may be charged as the principal culprits responsible for exhausting the world's iron ore supplies and for the very considerable consumption of fuel represented in the conversion of the ore to the finished metal. Nevertheless, it is difficult to perceive how engineers could economise in these respects by utilising more wood than they do at present. The civil engineer has all but completely abandoned wood for bridges, harbour works, piers, and other structures in favour of reinforced concrete. The electrical engineer does not use and never has used wood to any appreciable extent. In mechanical engineering the equipment of railways still absorbs large quantities of timber for sleepers, carriage and wagon bodies, buffer beams, and so on, but the tendency is quite clearly in the direction of decreasing rather than increasing the amount of wood so used. For shipbuilding purposes an extensive amount of timber is absorbed in the provision of internal finishings and deckings. The only direction in which the shipbuilders might economise iron and fuel by the employment of timber as a substitute would be by reverting to wooden hulls—an unthinkable course. For the present it is thus clear that engineers can do little towards promoting the economic use of wood in so far as their own structures and productions are concerned. We say at present, because it is quite conceivable that the progress of science may lead to processes for the treatment of wood which will endow it with new properties and possibilities. Of processes for the structural modification of wood we have already had a striking example in the development of three-ply material, a development which has led to many novel and extended applications of wood. Other modifying treatments are now being practised. While ordinary veneering is strictly a decorative modification, structural advantage is the prime object of a method, recently introduced, of applying to wood what is virtually a veneering of thin sheet metal. Again, by another recent development wood is produced in a plastic form which, when moulded quickly, sets to a hard strong condition and which, when set, can be operated upon by any of the usual woodworking tools. These developments may not amount to a revolution, but they clearly suggest that the engineer may yet come to regard wood as a structural material with much more consideration than he can give it at present. For the time being, however, we have to recognise that there is substantially no opportunity in engineering for extending the economic use of wood. On the other hand, in other directions opportunities undoubtedly exist for reducing its uneconomic use. The waste material originating in saw mills and woodworking shops is considerable, and so long as it is employed as a direct fuel we cannot be said to be taking full advantage of it. Difficulties of collection and treatment no doubt in many cases prevent its being subjected to destructive distillation, but it is worth while emphasising that economic considerations indicate that it should be subjected to that process, a process which recovers nearly the whole fuel value of the raw waste in the gaseous and solid products and whereof the intermediate products can be made to yield a long range of important industrial substances. The chief example of the uneconomic use of wood is, however, found, not in the saw mills, but in the pulp factories. The woods used for pulp making consist of round about 50 per cent. of cellulose—the only constituent of interest to the paper manufacturer—the balance being composed of about 25 per cent. of lignin and gums, resins, moisture, &c. In mechanical wood-pulp all the non-cellulose substances pass into the product, for no attempt is made to separate them. In the soda process the recovery of the sodium carbonate from the black liquor is the prime consideration and is accomplished by a method, involving evaporation, combustion and leaching, which is such as to leave a residue that is useless except as a low-grade fuel. In the sulphite and sulphate processes efforts to recover useful by-products from the resultant liquors have met with little technical and less commercial success. From the sulphite waste liquor the best that can be obtained is a heterogeneous road-binding material of doubtful value or, with much difficulty, a small percentage of ethyl alcohol. The sulphate liquor yields only a few easily isolated products, such as turpentine, wood alcohol and liquid resin. Altogether the pulp industry is responsible for the waste or misapplication of nearly half the weight of the timber which it absorbs.

It thus appears that while we are drawing upon our limited supplies of coal and iron ore without stint, we are simultaneously neglecting to take full economic advantage of our timber resources. Far from attempting to husband the coal and ore at

our disposal by the employment of wood instead, we are actually denuding the earth's surface of timber at a rate greatly in excess of the annual replacement. The engineer may exonerate himself from blame for his share in the matter by pointing to the virtual impossibility of adopting wood as a structural material in any increased measure likely to affect the situation. The pulp maker may say that the world's demand for paper could not be met without resort to wood, and that it is all but impracticable to convert wood into paper without wasting its valuable non-cellulose constituents. Both, however, have a clear responsibility to posterity which they cannot evade. The pulp maker may go some way towards relieving himself from blame by renewing his efforts to give a better account of the material he consumes or by taking care to see that he does not destroy more of it than is replaced by new growth or, most ideal of all, by abandoning the use of wood for some other material. The engineer's duty is perhaps of a less direct nature, although it is scarcely less important. It is his part to assist in the development of all processes leading to the more economic use of wood and particularly in the development of destructive distillation, which now forms the basis of a rapidly advancing industry. It is to him that the chemist must look for the provision of the extensive and varied plant required and for the devising of means for the best utilisation of the gaseous and solid products having a fuel value. In the remaining liquid portions derived from the process the chemist will then find ample room for work of the highest importance to industry and in the region of natural economics.

Railway Rates and Railway Wages.

THE announcement that the railway rates for the conveyance of general merchandise, coal, coke and other minerals have been reduced to 50 per cent. above the level existing on January 14th, 1920, has been generally welcomed. January 14th, 1920, may sound somewhat recent, and yet it was not until the following day that the first general increase in goods rates to meet the higher working costs was made by our railways. Generally, then, the present announcement may be regarded as an intimation that the rates are now 50 per cent. above pre-war level. We will not argue the point as to whether or not this reduction is the result of the threatened action before the Railway Rates Tribunal by the Federation of British Industries and the Mining Association, but prefer to believe that it is the outcome of a desire on the part of the companies to assist trade and also that it has some relation to the proposed standard charges deposited with the Rates Tribunal in accordance with Section 30 of the Railways Act. These charges—which include passenger fares and season ticket rates—are, under Section 31, to be considered and any objections thereto heard, and the Tribunal is then to name the "appointed day" on which they are to come into force. After that, says Section 33, there is to be "no variation, upwards or downwards," unless, as laid down in Section 35, a railway company or a representative body of traders satisfies the Tribunal that the standard charges ought to be modified.

What, at the present moment, is important is the effect the reductions now announced will have upon the relations between the companies and the men in the matter of the desire of the former to secure some revision of the concessions which were made in the spring of 1919. So much happened about that time and so much, naturally, has since been forgotten that it is desirable that the facts leading to those concessions should be remembered. To get the whole story we must go back to the threatened strike of enginemen exactly six years ago, when Sir Albert Stanley, the then President of the Board of Trade, promised that as soon as hostilities ceased the Government would consider the question of giving railwaymen the eight hours' day. The Armistice was signed on November 11th, 1918, and immediately the President was called upon to redeem his promise. This he did—not by considering, but by conceding the eight hours' day—on December 6th, and he then further agreed that a Committee should be appointed to consider the conditions of service. A strike of some of the men, more particularly on the Underground, the following February, revealed that the Government had done nothing towards setting up such a Committee; but it was done forthwith, and on March 27th a National Agreement was arrived at which gave the men very many benefits they had up till then not enjoyed. The companies undoubtedly were very generous at the time, but in the spirit then prevailing—a frame of mind brought about by the successful termination of the war, the splendid part played in it by the railwaymen and the reasonable ground for hope of good trade which appeared to exist—that was perhaps excusable. What the companies want now is that, just as the war bonus and the further concessions made by the National Wages Board in May, 1920, have disappeared under the reduced cost of living, so these more generous conditions shall be modified. It is important to note that there is no question of departing from the minimum rate of pay fixed in January, 1920, which was about 100 per cent. above the pre-war minimum, nor with the basic day of eight hours.

It would appear to be possible that the present reduction in rates may be used by the men's representatives to support an argument that it is not equitable to deprive them of some benefits in order to confer a favour on the traders—in other words, to rob Peter to pay Paul. That such a course may be taken is to be deduced from the president's address at the annual general meeting of the National Union of Railwaymen at Crewe a month ago. Mr. Marchbank, on that occasion, said that the increased dividends the railways were able to pay last year and the huge reserve funds which had been built up were conclusive proof that the companies were never in a more prosperous condition than they are at present. In former days, when wages and conditions of service were discussed, the men were always confronted with the poor financial position of the respective companies. If it was logical for the conditions to be determined by the prosperity in those days, it is equally so to-day. A decision in the matter does not, however, lie wholly with the companies or the men—that is, if the latter continue to seek for a modification in the terms of service. The discussions hitherto have been conducted by the two parties in the good spirit that has characterised their relations of recent years; but, having failed to agree, the question now goes to the Central Wages Board, by which body it is sure to be referred to the National Wages Board On the latter, in addition to the six representatives of the railways and the six of the men, there are the independent chairman, Sir William Mackenzie, and four representatives of the users of the railways, who may be trusted to sift the whole question and let the public know the merits of the case.

The Otira Tunnel, New Zealand.

(Contributed.)

THE first contract for a railway in New Zealand, that from Christchurch to Lyttelton, was made in 1860. Since then progress has been constant, and at present there are about 3000 miles of line open, with many new lines under construction. In Middle Island—more commonly called South Island—the greatest obstacle to successful railway construction was the high mountain range of the Southern Alps. The island, roughly 500 miles long by an average of 120 miles broad, is divided for nearly its whole length by this great range, with summits of from 10,000ft. to over 12,000ft., Mount Cook being 12,348ft. Lyttelton, the chosen terminus, was an important discharging and loading port for European and American vessels, Greymouth being but a bar harbour.

Ways and means of achieving the best route were investigated. In 1864 Mr. Arthur Dudley Dobson made a survey for a road over the mountains from Christchurch on the East Coast to Greymouth on the West, railway communication between which had from earliest colonisation days attracted great attention, especially among the residents of Canterbury and Westland. The way chosen was through Arthur's Pass, which runs down to the famous Otira Gorge. This survey naturally resulted in a considerable amount of useful information. Between 1878 and 1883 many more surveys of different possible routes were made. In 1883 a Royal Commission decided on the Arthur's Pass, with its summit 3000ft. above sea level, and it was finally adopted. A line with a 1 in 15 gradient over this pass, with a central rack rail on the Fell system, became the objective, and a syndicate called "The Chrystal" was formed to carry on the construction of the line now known as the Midland Railway, which had already been made from Christchurch as far as Springfield. This syndicate, in 1896, was merged into the Midland Railway Company, which was what is usually known as a land grant railway construction corporation, such as exists in Canada, and was founded in England by a syndicate which took over "The Chrystal." The original contracts were afterwards annulled, and a new one, dated August 3rd, 1888, between the New Zealand Government and the Midland Company was entered into, for a line from Springfield, in Canterbury, to Brunneston, near Greymouth, in Westland. The work was pushed on vigorously, but on the completion of the thirty-fifth mile the physical difficulties ahead were so considerable that the company abandoned the enterprise, with the result that the Government itself determined to take charge of the operations. From 1895 onwards the work was proceeded with as speedily as possible on both sides of the mountain range, and in 1890 a committee of engineers was set up to find the best means of traversing the range, whether by a 1 in 15 gradient line or by means of a long summit tunnel. Eventually a tunnel over 5 miles long and with a gradient of about 1 in 33 was decided upon. The eastern portal at the line summit is at Arthur's Pass Station, and the western portal in the gorge of Rolleston River, 3¼ miles above Otira, which is 52 miles from Greymouth, Arthur's Pass being 85 miles from the other terminus, Christchurch. The location once decided, final surveys were made over the mountain on both sides, and a series of trigonometrical stations founded. On August 12th, 1907, Messrs. J. H. McLean and Sons got the contract for £599,794, with a stipulation for completion in five years. In April, 1908, the work of driving the bottom headway was begun at the Otira end. The inauguration of the undertaking took place on May 5th, when Sir J. H. Ward, Prime Minister, fired the first shot. On July 1st, 1909, the Arthur's Pass portal was commenced.

After £250,000 had been spent the contractors found that it would be impossible for them to complete the tunnel for the contract sum. A Parliamentary Committee then decided that fresh tenders should be called for and that the Public Works Department should, in the meanwhile, go on with the work. As no firms came forward to face the task, the Department itself undertook responsibility and eventually, having overcome all the obstacles met with, made the tunnel an accomplished fact, the official opening having taken place on Monday last.

Though the summit tunnel is by far the most important on the line, it is not the only one, for there are many shorter tunnels as well as numerous bridges. In a short length of 9 miles there are three high steel viaducts, one with rails 235ft. above the floor of the gorge it traverses, and no less than seventeen short tunnels, the longest being about 2000ft., while there is scarcely a mile of level on the whole line. There was also a very considerable amount of work for protecting embankments from torrents, which in times of flood are of great violence.

The exact length of the Arthur or Otira Tunnel is 5 miles 554 yards, all on the straight. The gradient is 1 in 33 and the height ascended is from 1585ft. above sea level at the western end to 2435ft. on the eastern end. The line is 3ft. 6in. gauge, *i.e.*, standard New Zealand Railway. The clear height above rail level is 15ft. 6in. maximum. The tunnel is—except a few hundred feet at the portals—in solid rock of variable hardness and fissured badly—so that explosives were most effective—but gritty and hard on drill steel or rods, and in places changing abruptly from very hard to medium sandstone and indurated slaty shale.

Temporary timbering was used throughout to guard against flaking, which was fairly heavy in the worst places. The timber was got just outside the west portal. Wet and dry—occasionally very wet—ground was met, but no great volume of water needing special measures and methods, as in the Simplon and the Loetschberg and other tunnels. There was at one time a flow of 2000 gallons per minute, but now there is hardly any. The excavation was by the bottom heading method and enlargement to full section, *i.e.*, a bottom heading drive of about 8ft. high and 10ft. wide being first made. The best average of progress was 13½ft. per day for twelve days. Timbering was done where necessary in the headings, and the full section excavated with lagging for concreting, the lining being kept as close as could be to the full section. The concrete, machine mixed, was of one part (by volume) cement to two sand and five shingle. The blocks for the top of the arch were made outside the tunnel and allowed to mature for three months. Materials were available at each end, but good sand was scarce, which necessitated use of grinding machinery at one end for a time. Compressed air was employed for working the blasting drills, two or three of which were in use at each heading, and others elsewhere where necessary. The air was taken to the working faces by a 5in. main at one end and a 6in. at the other. Direct-current hydro-electric plants at each end gave power for the air compressors, lighting, driving electric mine locomotives, and miscellaneous machinery. The voltage at each end was 500. At the east end electricity was also used for pumping.

Air-driven winches and wire ropes effected haulage from the faces to the completed parts. Ten-ton electric mine locomotives of 2ft. 6in. gauge and bare overhead trolley wire were used for transporting the excavated materials, timber and concrete. Each had a drum with insulated cable, re-winding motor and brake, and the cable being hooked to the end of the wire enabled a run of 1300ft. on and up to the working faces, thus avoiding the use of a suspended bare trolley wire on the uncompleted part.

Ventilation was secured by a system of air exhaustion from the working faces. A Roots blower with a capacity of 4000 cubic feet per minute was set

up at each end, and it drew the air through a 16in. riveted steel pipe which reached to the finished parts. The exhaust air from air drills further ventilated the working faces. At first an attempt was made to effect ventilation by the release of compressed air at the face, it being considered that the impure air would be driven out along the tunnel. The experiment was, however, a failure, so a change to the exhaust system was made.

Incandescent electric lamps, two each of 250 volts, in series, were employed for lighting the external works and the completed portions of the tunnel, but for inside operations a voltage of 500 was considered to be too high, and acetylene miners' hand lamps were used by the men.

The progress of the work has been slow and the estimated time and cost considerably exceeded; but since the taking over of the work by the Public Works Department in 1912, when the bottom headings were completed for 2½ miles and the tunnel for about 1¾ miles, progress has, at any rate, been steady. The bottom headings met 3 miles 68 chains from the Otira end and 1 mile 36 chains from the Arthur's Pass end, on July 20th, 1918, the difference in level being 1½in. and in alignment of only ¾in. For the purpose of comparison it may be mentioned that in the Mont Cenis Tunnel the difference in level of the two headings was 1ft. and in alignment nil. On August 21st, 1918, the final barrier in the bottom heading was shot away by Sir William Fraser, the Minister of Public Works, and by last April the whole of the excavation and lining had been completed.

The tunnel, which, as has been said above, is 5 miles 554 yards—or 28,062ft.—long, is the longest tunnel in the British Empire and the seventh longest in the world. In its construction serious and fatal accidents have been few.

It has been decided in view of the steep gradient, and of the trouble with smoke had locomotives been used, to employ electricity as the motive power, and it was decided to equip for electric traction the 8¾ miles of line from Otira to Arthur's Pass. The generating station, which is steam driven, is at the Otira end, and the overhead system with 1500 volts direct current will be used. The contract for the electrical equipment, including locomotives, the overhead work and the turbo-generators, was given to the English Electric Company, which has now completed its work.

The Steam Yacht Restless.

A NEW steam yacht, the Restless, after exhaustive trials on the Clyde, was recently handed over to Captain Alexander Smith Cochran, for whom she has been built by John Brown and Co., Limited, of Clydebank. This yacht, a view of which we show on her trials in Fig. 1, was designed by G. L. Watson and Co., naval architects, of Glasgow, and constructed under their supervision. As she is different in type and arrangement from what is customary, a brief description of her principal features may be of interest.

The Restless is about 750 tons, according to Thames measurement rating, but as she has a straight bow and what is generally called a cruiser stern, she is really a larger vessel than her tonnage indicates. She has been planned by her owner, who is a qualified master, for his own particular purposes and use, and is specially equipped for long ocean cruises. Forward, she is built up above the main deck, giving her a powerful bow; amidships there is a shade deck; and aft, a raised quarter deck. She is rigged as a pole-masted schooner, the spars being of very moderate length. The arrangement of the accommodation and machinery spaces will be seen from the deck plans reproduced in Fig. 2. The owner's accommodation is forward. On the main deck is his bedroom on the starboard side, and his dressing-room on the port side, the two rooms occupying the full breadth of the yacht, large double doors between the two allowing them, if desired, to be made practically into one. A stairway at the aft end of the state-room goes up to the owner's navigating room in the forward deck-house on the upper deck. A vestibule and a chart room are placed aft of this navigating room.

Immediately aft of the owner's rooms on the main deck is the dining-room, with a double door entrance under shelter, on the starboard side. There is also another door from this room leading to the deck on the port side. The pantry and galley are conveniently situated just aft of the dining-room. On the main deck aft, under the shade deck, is the living-room, which is entered from a vestibule on the starboard side. From the same vestibule a stairway goes down just aft of the engine-room bulkhead, to the guests' state-rooms and other accommodation, whilst a stair from the vestibule leads up to the smoking-room on the shade deck aft of the main mast.

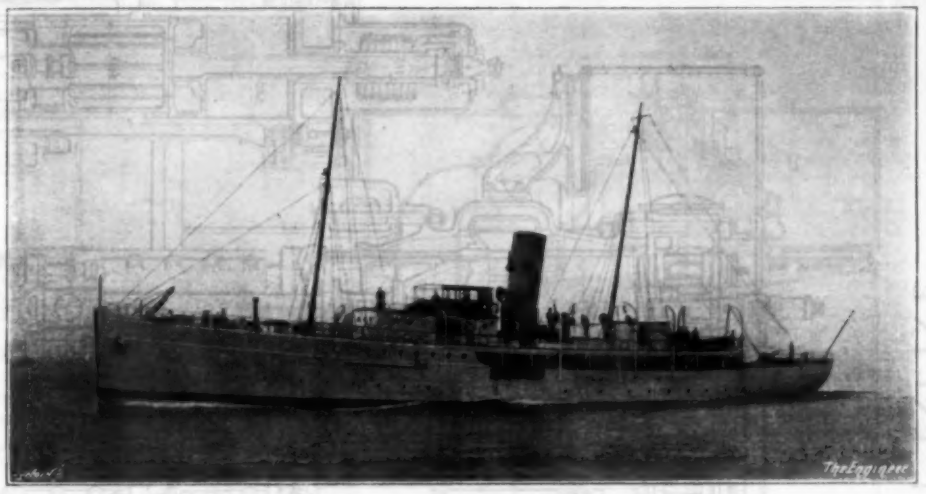


FIG. 1—THE 750-TON CLYDE BUILT STEAM YACHT RESTLESS

The officers and crew have exceptionally fine accommodation forward. On the main deck there is a large open space or well, with shutters on each side of the ship. These shutters are hinged up under the upper deck in fine weather, and, on one or both sides as necessary, they may be closed in dirty weather. The officers and crew have independent entrances to their quarters below from this well. The mess-room and officers' cabins and the men's sleeping quarters are below the main deck, while the crew's galley, the officers' and crew's bath-rooms and other accommodation are situated above the main deck forward. The yacht is fitted with a wireless installation, and the wireless room is placed under the quarter deck. In addition to the accommodation we have described, there are also ample store-rooms and cold chambers in the forward hold and under the men's quarters. As will be seen from the illustrations accompanying this article, two motor launches, two lifeboats and two dinghies are carried, all of which were designed and built to comply with the yacht's particular requirements.

PROPELLING MACHINERY.

Although great advances have been made with the marine oil engine, in the present case, for several reasons, steam propulsion has been preferred. The twin-screw machinery comprises two four-crank triple-expansion engines. The high-pressure and intermediate-pressure cylinders are 12in. and 19½in. in diameter respectively, and the two low-pressure cylinders are 22in. in diameter, all having a stroke of 20in. The engines are balanced on the Yarrow-Schlick-Tweedy system, and their running during the trials showed a remarkable absence of vibration. As regards constructional details, the engines are of similar design to those of the yacht Sapphire, which were constructed by the same builders, and were described and illustrated in THE ENGINEER of November 7th, 1913. Steam is generated in two Scotch single-ended boilers, the larger of which is of sufficient capacity to give the yacht a cruising speed of about 10½ knots, the other boiler being so arranged that it may be used as an auxiliary when extra speed is required. Oil firing on the Wallsend system is provided for, and a prolonged fuel consumption trial showed that the Restless should have a cruising radius of about 6000 miles at 10 knots.

The object of the owner has been to produce a seaworthy vessel, furnished in a simple but comfortable manner, equally suitable for a home and for long ocean voyages; in other words, a ship in the essential meaning of the term. Everything required for this purpose has been provided, and whatever was considered unnecessary has been eliminated. The Restless does credit to her owner and builders, and is a further addition to the many famous yachts which have been designed by G. L. Watson and Co.

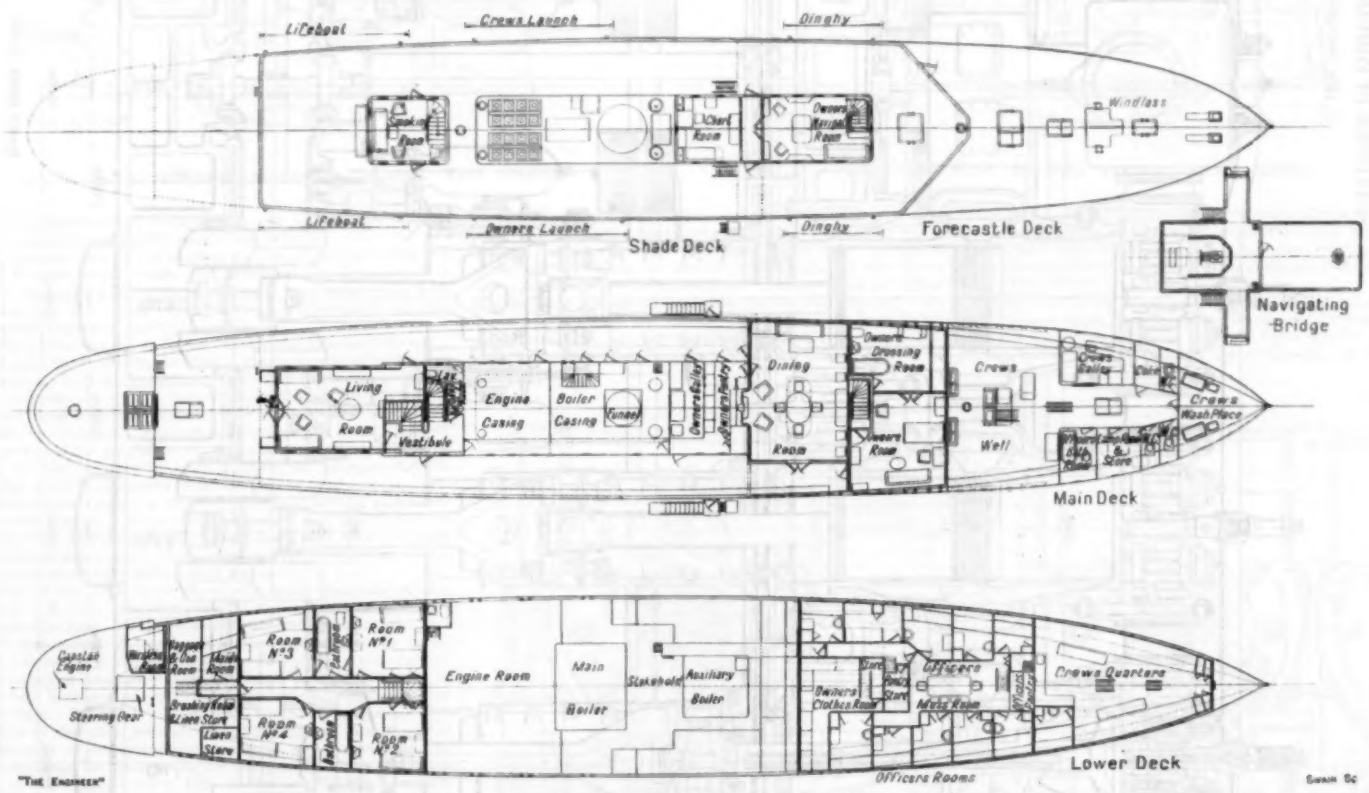
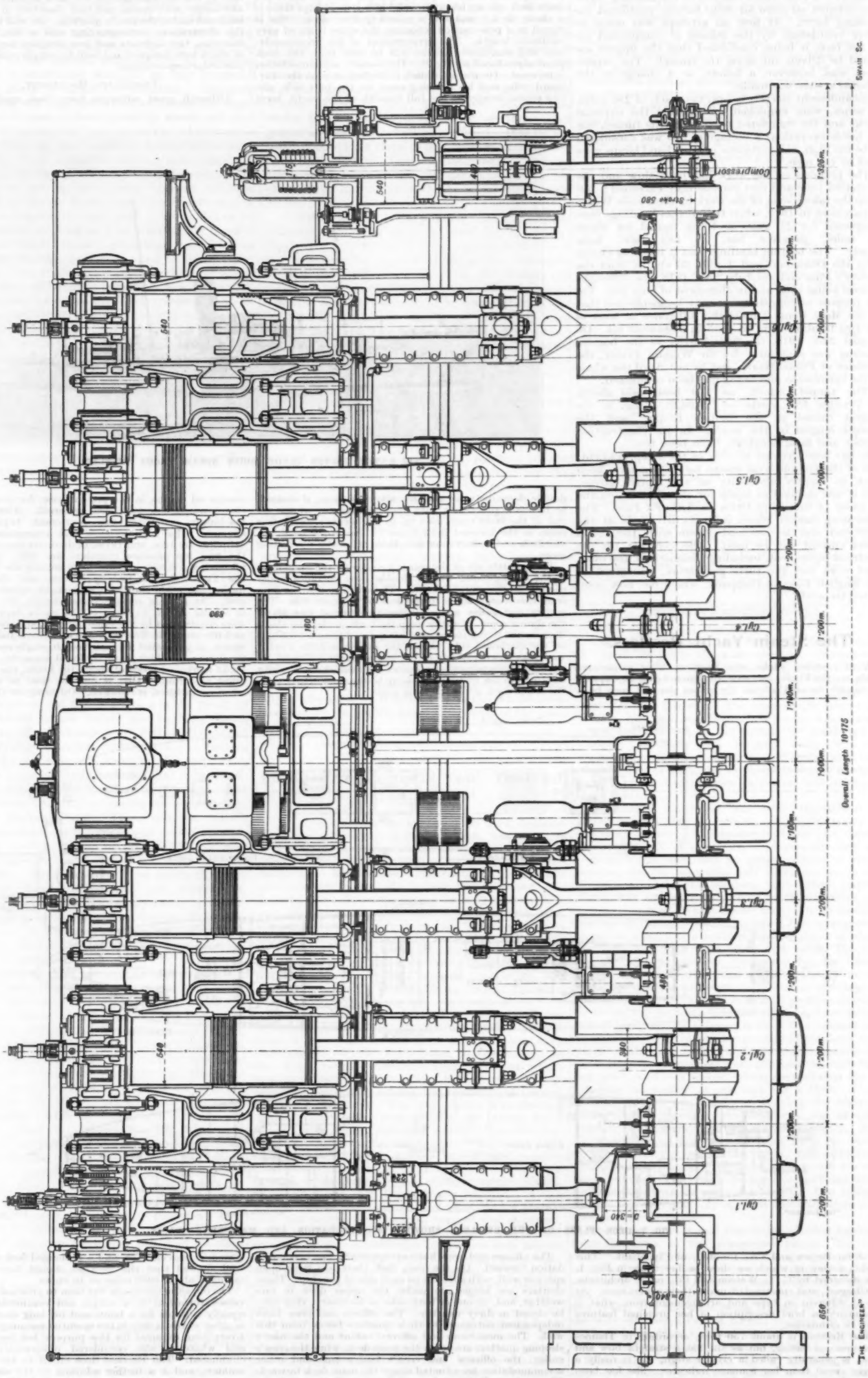


FIG. 2—DECK PLANS OF THE RESTLESS, SHOWING ACCOMMODATION AND MACHINERY SPACES

1500-B.H.P. CARGO BOAT TYPE MARINE DIESEL ENGINE

SCHNEIDER ET COMPAGNIE, LE HAVRE, ENGINEERS

(For description see opposite page.)



Recent Schneider-Diesel Oil Engines.

REFERENCE has already been made in our columns to a new heavy type of marine oil engine which has been designed by Schneider et Cie., and constructed at the firm's engineering works at Le Havre. On the occasion of the visit paid to these works by the members of the Institution of Naval Architects attending last year's summer meetings in France, one of these engines was seen on the test bed approaching completion, and we are now able to give some further particulars concerning it.

A general view of the engine, coupled direct to a Heenan and Froude water brake and arranged for shop trials is given on page 152, while the details of construction and design are shown in the drawings reproduced on the opposite page and in Figs. 1 to 3.

The engine is a six-cylinder unit, with cylinders 540 mm., or 21¼in., in diameter, and has a piston stroke of 800 mm., or 31½in. It is designed to develop 250 brake horse-power per cylinder, or a total output of 1500 brake horse-power at 140 revolutions per minute, and 1800 at the higher speed of 150 revolutions. Since equal success has been achieved by motor ships propelled by engines running at speeds of 120 to 130 revolutions per minute, as compared with similar vessels equipped with slower-running engines, the makers have chosen a relatively high speed as a feature of their design. This choice confers the advantage of lighter weight with a smaller crank shaft, while the cylinders are less in diameter with a corresponding reduction in the cylinder areas exposed to heat stresses.

Figs. 1 to 3 serve to show the main features of the design. A cast iron bed-plate of substantial proportions carries the main rectangular columns which are furnished with water-cooled crosshead slipper guides at the back, while these, in turn, support an entablature which carries the cylinder casings. The scavenge pumps are two in number, and are bolted to the back columns of the centre cylinders. They are driven from the main crossheads by means of the link gear shown in Fig. 2. A scavenge air main runs at the cylinder cover level, and is connected to the scavenge air passage in the covers. At the right-hand end of the engine—see p. 156—is the air compressor which is of the three-stage type, and is driven from the extended crank shaft, and mounted at the end of the main bed-plate.

Returning to the main cylinders, it may be noted that the cylinder casings with the exhaust and cooling water passages are made of cast iron, and are furnished with ample sized inspection doors. The cylinder liners, which are provided with ports for the exhaust, are made from a special close-grained cast iron, and are supported by the casings, both at the centre and also at the top and bottom ends in the usual manner. The piston is constructed in two parts, with a loose crown of toughened cast iron and a cast steel skirt. Like the cylinder covers and liners, the piston is cooled with sea water, and the arrangement of the water-cooling pipes and gear is shown in Figs. 1 and 2. The firm of Schneider et Cie. is justly famed for its cast steel products, and it is therefore not surprising to find that cast steel cylinder covers are used. Each cover—see Fig. 3—is furnished with four scavenge air valves, one fuel valve, one starting valve, and also a safety valve, and the design of the cover is such that as far as possible an equal section of metal is obtained in all directions, with a uniform distribution of stress.

The valves are operated by push rods in the manner shown in Fig. 1, the motion being derived from a horizontal cam shaft which runs the length of the engine, which is driven from a centre vertical shaft geared to the crank shaft by the bevel and skew gear illustrated in Fig. 2. A neat casing encloses the cam shaft, cams, and push rods, access for adjustment being provided through inspection doors. The valve levers are mounted on a fulcrum shaft, which is moved by a cam motion in such a way that when starting the engine the cylinders come into operation successively. When in the stop position, all the lever rollers are lifted free from the cams. The cams are arranged in pairs, one for ahead and one for astern running, and reversal is effected by sliding the cam shaft in a horizontal direction. A servo-motor, worked by compressed air, effects this operation and a special safety device is fitted, so that the cam shaft cannot be moved unless the manœuvring shaft is in the stop position, with the rollers lifted clear of the cams.

Each cylinder is furnished with its own fuel pump, and the pumps are placed together in two groups of three at the front of the engine. Two further auxiliary pumps are provided, one being attached to each group. These auxiliary pumps may be used to deliver a small quantity of ignition oil to the fuel valves, which are arranged for pilot ignition, thus enabling heavy fuel oils to be used. The amount of oil delivered by the pumps may be controlled by hand, by the starting and manœuvring mechanism, or by a special emergency governor, which prevents racing. The oiling of the main bearings and connecting-rod ends is effected by mechanical lubricators working under a low-pressure head, and the oil from these parts is collected in a sump in the bed-plate, and is again used after cooling and filtering. Special precautions are taken to prevent oil being thrown from the crank shaft. The lubricating oil supply for the connecting-rod top ends and the crossheads and slippers is furnished by means of a small oil pump. Electrically operated turning gear is fitted to the engine and access to all working parts is given by a well-arranged series of platforms and gangways. The total weight of the engine in running order, including the exhaust piping and platforms, is about 190,000 kilos., or nearly 187 tons.

Although French shipowners are somewhat reluctant to order motor ships, and delay has occurred in the provision of hulls for these engines, there is little doubt that the slower speed engine evolved by Schneider et Cie. will eventually prove as successful as the numerous high-speed submarine engines which have, in the French and other navies, given good and reliable service, both before 1914 and during the war and post-war periods. In the French Navy, in particular, although for natural reasons the naval authorities have not accorded a monopoly to Schneider engines, both the two-cycle and four-cycle types of engines manufactured by the firm have, we understand, proved particularly acceptable to the submarine officers and engineers.

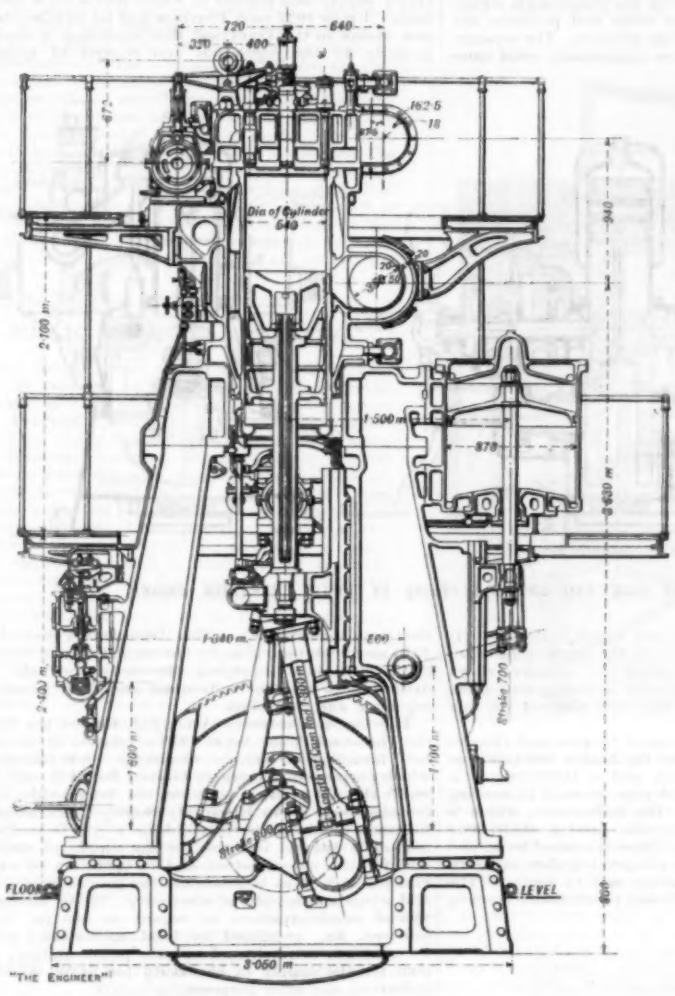


FIG. 1—SECTIONAL ELEVATION THROUGH MAIN CYLINDER

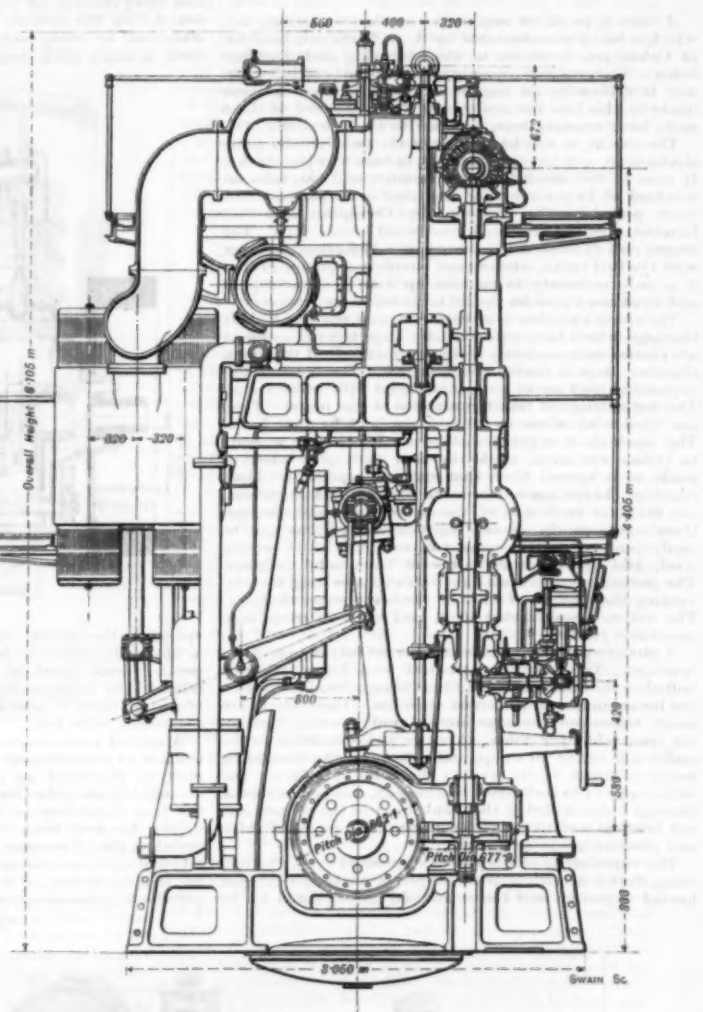


FIG. 2—END VIEW, SHOWING VERTICAL SHAFT DRIVE

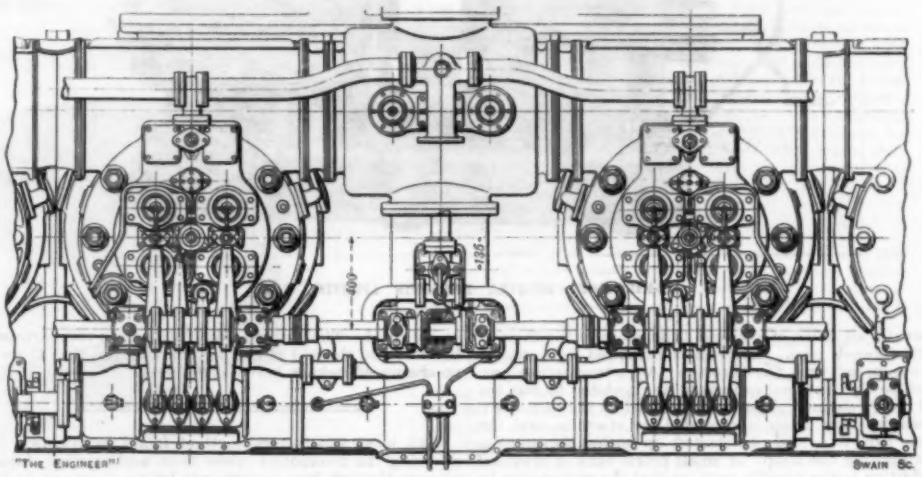


FIG. 3—PLAN VIEW OF THE TWO CENTRE CYLINDERS

We illustrate on page 152 a set of engines for the French submarine Joessel, which are of the 1500 brake horse-power two-stroke cycle type, running at a speed of 330 revolutions per minute. The French Government has, we learn, recently ordered engines of a similar type, which will be installed in the submarines which are to be constructed under the present naval programme.

Two-Cylinder Paraffin Lighting Set.

A new type of oil engine driven electric lighting set, which is being manufactured by A. G. Mumford, Limited, of Colchester, is shown in the engraving and drawings below. The set has a capacity of 10 kilowatts at 105 volts, and is driven by an engine somewhat similar to those made by this firm for motor boat work. Several of these units have recently been supplied to the Admiralty.

The engine, it will be seen, is of the two-cylinder four-stroke type, and has cylinders 5in. in bore by 6½in. stroke. It runs at 900 revolutions per minute, and can take an overload of 10 per cent. for one hour or 20 per cent. for short periods. The dynamo, by Crompton and Co., Limited, is of the protected, compound-wound type. The engine and dynamo are mounted on a bed-plate, together with the fuel tanks, silencer and circulating pump, so that it is only necessary to connect up with a water supply and an exhaust pipe for the set to be ready for service.

The crank chamber is of cast iron, and the crank shaft bearings, which have exceptionally large bearing surfaces, are carried independently in the bottom half of the crank chamber, as in a marine steam engine. The bearings are adjustable, and are of gun-metal, lined with white metal. The connecting-rod bearings are also of gun-metal. They are lined with white metal and are held by four bolts. The crank shaft is fitted with four steel balance weights to reduce vibration, while the cam shaft gear wheel is made of a special fibre that ensures practically silent running. Large inspection doors, secured by a single nut, are fitted at each side of the crank case, and through these openings the connecting-rods and pistons can be easily removed. The connecting-rods are of H section steel, and are machined all over from solid forgings. The pistons are fitted with an extra scraper ring for preventing the passage of oil into the combustion chamber. The valves are of nickel steel, and work in extra long renewable guides.

A plunger pump is used for the forced lubrication of the bearings. This pump is attached to a lower oil sump bolted on the crank chamber, filters being provided between the lower sump and the crank chamber. These filters are easily taken out for examination and cleaning through the crank chamber doors. A water jacket is fitted to the under side of the oil sump, and through it the circulating water is drawn on its way to the main cylinders. The oil is supplied to each main bearing cap, and passes thence through holes drilled in the crank shaft to the connecting-rod bearings and to the gudgeon pins. An oil relief valve and pressure gauge are fitted.

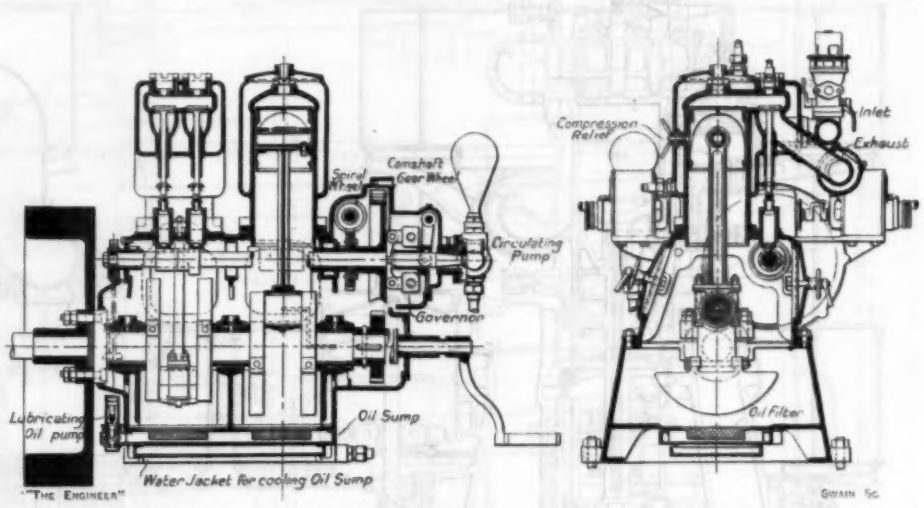
The vaporiser is of the maker's patented type, the fuel being drawn in with a small supply of air to the exhaust heated vaporiser, and the extra cold air regulated by an automatic air valve of a special type, close to the throttle on the branch pipe. The fuel is regulated by a needle valve coupled with the throttle. Adjustments are provided, so that the fuel can easily be regulated to suit the load on the engine. A governor is fitted on the cam shaft. A paraffin blow lamp is provided for starting, and the engine can, it is said, be started up within six minutes from lighting the lamp. A small petrol tank is provided in addition to the paraffin tank, so that the engine may be started on petrol if preferred.

The circulating water pump is of the plunger type, on account of the high suction lift required in the conditions under which these engines work. The pump is driven from a crank disc on the end of the cam shaft. A centrifugal oiling arrangement supplies oil to the crank pin and to the gudgeon pin of the pump. The pump is fitted with special rubber disc valves and a delivery air vessel, and has proved very silent in operation, although running at rather a high speed.

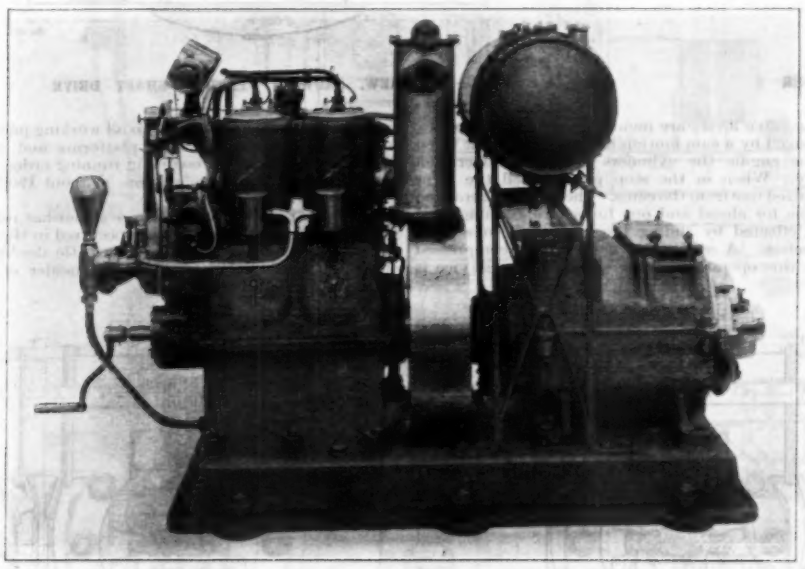
The ignition of the charge is effected by two magnetos, two plugs being fitted to each cylinder. One of the magnetos is fitted with an impulse coupling. This arrangement, together with the special type of relief valve fitted to the cylinder, makes the starting of the engine exceptionally easy. The two separate magnetos, each with variable ignition with two separate plugs, are considered by the makers far better than either a dual magneto or than the use of one plug for magneto and one for battery and coil ignition.

A simple compression release arrangement is fitted for facilitating starting. It comprises a non-return valve so arranged that it can make a tight joint on the cylinder, when screwed up by a sleeve. When slightly unscrewed, this valve relieves the pressure on the compression stroke, but during the suction stroke closes and prevents any additional air being added to the mixture. The arrangement is much more simple than compression relief cams operating the exhaust valves, and equally effective. It is obviously infinitely better than the more usual compression cock fitted at the top of the cylinder, which relieves the high-pressure air with a consequent waste of power, while it also allows the chief effort of the first explosions to be lost.

A special arrangement of exhaust by-pass and throttle is fitted to these engines, so that the heat of the vaporiser may be regulated as required, and a thermometer is arranged in the induction branch pipe, to assist in securing the best regulation of heat. The tachometer, which is driven by belt from the magneto driving shaft, two switches, the oil pressure gauge, throttle control lever, and oil relief valve are conveniently grouped together, as shown by the engraving, at the starting end of motor. The paraffin tank has a capacity sufficient for six hours' running on full load. The petrol tank is a separate compartment bolted on to the end of the paraffin tank, so that there is no chance of leakage between the two.



SECTIONAL SIDE AND END ELEVATIONS OF 10-K.W. PARAFFIN ENGINE



10-KILOWATT 105-VOLT PARAFFIN LIGHTING SET

The most satisfactory method found in America for relieving the locomotive crews from asphyxiation during passage through long tunnels was by supplying air to the men through respirators attached to the train air brake pipe line. A supply of air was led from the pipe by means of a rubber hose, which was, in turn, attached to an ordinary funnel. During the passage of the locomotive through the tunnel the wearer held the funnel to his face and breathed fresh air supplied from the train pipe. The supply of air was regulated by a small orifice and valve. With this protection the wearer was able to breathe normally. The air tanks in the train pipe, acting as reservoirs, will afford a supply of pure air, which will last 30 minutes.

South African Electricity Supply Commission.

The following memorandum concerning the formation and functions of the Electricity Supply Commission of the Union of South Africa, has been forwarded to the Department of Overseas Trade by H.M. Senior Trade Commissioner in South Africa:—The Electricity Act, 1922, is the only co-ordinating legislation that has been passed by the Union Parliament to regulate the supply and control of electricity. For the first time it places electricity supply and control in South Africa on a national basis. Up to 1922 each Province had its own legislation, and, except in the Transvaal, that legislation related particularly to the regulation and control of municipal electrical undertakings. The Transvaal Power Act of 1910 provided, *inter alia*, for the regulation and control of all undertakings supplying electricity for sale. Such undertakings had to be licensed and their prices were regulated and controlled.

The Union Electricity Act, 1922, follows the lines of the Transvaal Power Act of 1910 in relation to the control and licensing of private electricity undertakings, for which purpose an Electricity Control Board is constituted under the Act: but, in addition, the Act provides for the establishment of an Electricity Supply Commission, the functions of which are threefold, *i.e.*:—(1) To investigate new or additional facilities for the supply of electricity and for the co-ordination and co-operation of existing undertakings so as to stimulate the provision of a cheap and abundant supply of electricity; (2) to advise provincial administrations in regard to electric lighting schemes, &c., promoted by local authorities; and (3) to establish, acquire, and operate power stations of its own for the supply of electricity for State, municipal, industrial, and other purposes.

Before it can establish or acquire a power supply undertaking the commission must apply to the Control Board for a licence in the same way as a private company. It must also submit its report and proposals to the Government for approval, and upon approval of the scheme by the Government, the Governor-General authorises the commission to raise the necessary loan.

The Electricity Supply Commission, consisting of one full-time member and two part-time members, was appointed by the Union Government on March 1st, 1923. The chairman and full-time member of the Commission is Dr. H. J. van der Bijl, and the part-time members Messrs. R. Niven and J. R. Fulton, both of Johannesburg. The headquarters of the Commission will be in Johannesburg, where it opened its offices on May 1st last.

Several electrical schemes are already engaging the Commission's consideration. An investigation in terms of the Electricity Act is proceeding with regard to the electrical power requirements and potentialities of the Witbank area. Witbank is the centre of the Transvaal goldfields, and an eminently suitable area for the generation and distribution of electricity on a large scale. A new power station is required at Durban for municipal purposes. The Commission has commenced negotiation with the Durban Municipality and has offered to build a large station there to provide for municipal and railway and harbour requirements in the Durban area, the electrification of the main line between Durban and Pietermaritzburg, and industrial and other purposes along the railway route.

The Railway Administration has under construction at Colenso, in connection with the electrification of the railway line between Pietermaritzburg and Glencoe Junction, a large power station which will contain 5 turbo-alternator sets, each having a normal capacity of 12,000 kilowatts, but capable of carrying 15,000 kilowatts for short periods, and as much as 20,000 kilowatts for two minutes at a time. The intention is that the Commission shall take over the station and the transmission lines in connection therewith, and in the event of the Durban power station being built by the Commission, the stations at Durban and Colenso will be linked up and worked in unison.

The Commission is empowered to raise money by means of loans for the purpose of financing its undertakings, and, in the first four years after its establishment, it may also obtain advances for such sums as it requires from the Union Treasury. It has also complete control over all its officers and employees who are servants of the Commission and not public servants. The Act provides that the accounts of the Commission shall be audited by two or more public accountants.

The Commission has very wide powers under the Act Once proposals for the establishment or acquisition of

a new power supply undertaking have been approved by Government, the Commission is free to function on business lines without Government intervention and subject only to the provisions of the Act, and the powers exercised by the control Board, which stands in the same relation to the Commission as it does to a private power company.

Each station established or acquired by the Commission has to be worked as a separate undertaking, all profits arising therefrom, after meeting operating, interest, renewal, and amortisation charges, to be used towards reducing prices and stimulating the use of electricity.

The Commission is a business undertaking intended to combine the elasticity and freedom of action of private enterprise with the advantages of a national institution as regards the facility for raising capital, the elimination of private profits, and the development of the use of electricity for domestic, industrial and farm purposes.

The constitution of the Commission follows no particular precedent. The Union Electricity Act was designed to meet South African conditions. Electricity Commissions have been established and are operating successfully in Ontario, Canada, and Victoria, Australia, but while their main objective is the same, namely, to promote the use of electricity and stimulate a cheap and abundant supply, there are fundamental differences in their constitution and manner in which they function. Much is expected from the South African Commission in the direction of fostering industrial development, railway electrification, and the establishment of by-product industries.

NEW PUBLIC WORKS IN ARGENTINA.

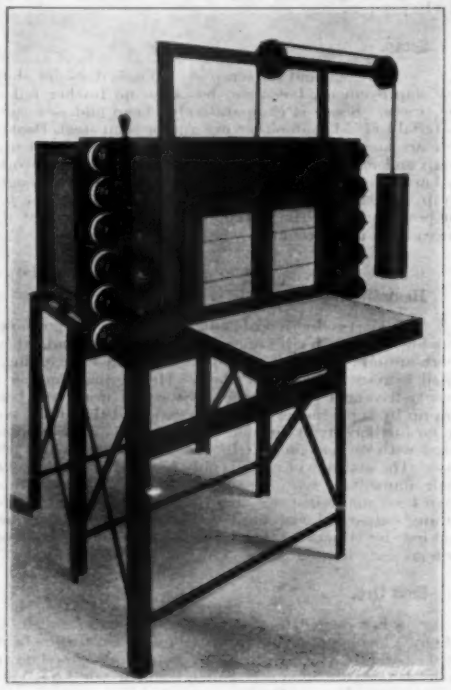
In view of the improved trade conditions throughout Argentina, as reflected in the latest official statistics, encouragement is being afforded for the carrying out of a number of deferred provincial and municipal improvements. Several of the larger towns, such as Rosario-de-Santa-Fé, Mendoza, Tucumán, &c., have drawn up programmes in consultation with, and with the approval of, the National Government, which, through the Obras Sanitarias de la Nacion, lends financial assistance to Provincial Governments for the construction of public works. Among other schemes accepted and which, it is understood, will be proceeded with as funds become available, are the following:—In the Province of Córdoba, water supply systems for the capital, Córdoba, and the towns of Villa Maria and Villa Neuva; in the Province of Jujúy, sewage system for the capital—Jujúy—and water supply systems for the towns of San Pedro and Ledesma; in the Province of Santa Fé, water supply system for the towns of Esperanza, Casilida, Rafaela; in the Province of Santiago-del-Estero, amplification of water supply and sewers in the capital, and the introduction of rain water sewers; in the Province of San Juan, amplification of the water supply in the capital and surrounding departments; in the Province of Entre Rios, water supply systems for the towns of Concordia, Concepción-del-Uruguay and Gualeguaychu; in the Province of Mendoza, water supply systems for the towns of Tunuyán, Las Heras and San José de Guaymallen; and in the Province of Tucumán, the installation of rain water sewers in the towns of that name. The total estimated cost of these works exceeds 10,000,000 dollars gold—£2,000,000.

FURNACES WITH INTERNAL ELECTRIC HEATERS.

We have on several occasions referred to the Wild-Barfield electrically-heated furnaces, manufactured by Automatic Electric Furnaces, Limited, of 173–5, Farringdon-road, London, E.C. 1, and described the method of their operation at some length. The majority of the furnaces constructed so far have been of comparatively small capacity, and it has not been possible to accommodate big loads of material or large articles. A new type of furnace, illustrated by the accompanying engravings—has, however, recently been produced to cope with such conditions, and it appears to be well suited for the purpose.

The characteristic feature of the new furnace is the arrangement of the heating elements in such a manner that the work is subjected to direct radiation from the resistance wire without there being any fear of contact between the two, or of the element falling out of place.

The furnace is built up, on the unit principle, of refractory bricks, each measuring 4in. by 4in. The edges of the bricks dovetail into one another, whilst there are three grooves across the front face. These grooves, as will be seen from the engraving, are of more or less circular cross section, with an opening, on the face of the brick, slightly less in width than the diameter of the circular part of the slot. The bricks are built up so that the grooves form continuous channels along the walls, roof and floor. The heating units, in the form of wire spirals or rods, are drawn into these grooves after the bricks have been assembled.

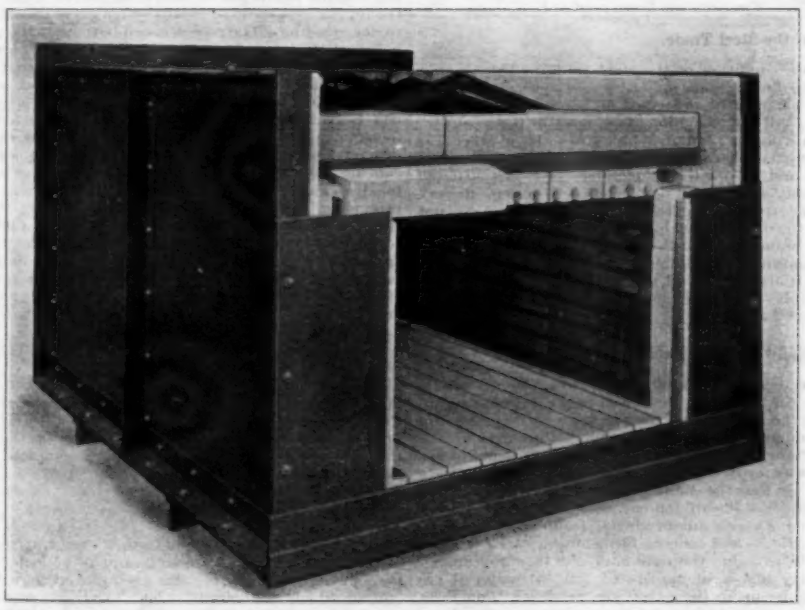


FURNACE ON STAND WITH SWITCHES

The heaters are, of course, given freedom to expand in all directions, but cannot drop out of the grooves.

The bricks which form the roof of the furnace are of a special form and are recessed so that they may be hung beneath transverse girders. The girders are of specially treated iron or nickel chrome and, as will be seen from the engraving, are supported at the centre by a truss. The whole furnace is surrounded by a casing of boiler plate, stiffened by angle iron, and the space between the bricks and casing is packed with insulating material. The door is built up of fire-bricks in a metal framing, and its weight is usually counterbalanced as illustrated. The temperature of the furnace is controlled by means of sets of switches mounted on the side wings of the front.

With these furnaces, the makers inform us, it is possible to reach a temperature of 800 deg. Cent. in half an hour, when starting from cold, while it requires about 1¼ hour to attain 1000 deg. Cent. The power consumption may be gauged from the fact that a furnace 20ft. long by 12ft. high and 12ft. wide requires 1400 kilowatts per hour to obtain a temperature of 1000 deg. Cent., but the same size of furnace when used for non-ferrous annealing at 500 deg. Cent., only needs 490 kilowatts. A carburising furnace 24in. by 12in. by 12in. can be heated in one hour to 900 deg. Cent., with a consumption of 11 kilowatts.



RADIANT HEAT ELECTRIC FURNACE

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Holidays.

Hardly any work has been done in Staffordshire and the Midlands this week, most firms having closed down for a full week. One or two steel works have, however, been in partial operation, as have been a few of the heavy engineering concerns. The iron and steel market at Birmingham to-day—Thursday—was but poorly attended and practically unproductive of business. There will not be a big demand for material this month, for, following upon this week of inactivity, towards the end of the month the Black Country wakes will be held, and these will involve practically a further week's stoppage. There was not sufficient business being done on 'Change to-day to enable one to judge as to market values. Prices, however, with the exception of those of galvanised sheets, which have advanced a further 5s. for home and 10s. for export, remain pretty much as last week.

Increased Production Costs.

Ironmasters in the Midlands are faced with a substantial addition to their production costs, for workers in the industry are to receive enhanced wages for the next two months. The announcement of a 7½ per cent. advance in wages under the figures of the May-June ascertainment of the Midland Iron and Steel Wages Board caused considerable surprise, for even those most concerned with the trade did not expect so large an advance. The explanation is that the ascertainment relates to contracts placed in the earlier months of the year, when prices were at an abnormal level owing to dear fuel and pig iron. In March and in April marked bars underwent two advances of 10s. each, bringing them to the present basis of £14 10s., and that unquestionably has been a big factor. Of course, ironmasters have had their return in the higher prices that prevailed during May and June; but we have now the anomalous position of wages being advanced while values are falling, and this is bound to act as a further handicap in the search for trade. The next ascertainment will probably reflect the recent decline in values unless in the meantime things take a turn for the better. It is interesting to note that this advance in wages is the third since the beginning of the year, amounting in the aggregate to 17½ per cent., and bringing the plusage over the base rate of 13s. 6d. up to 57½ per cent. The average net selling price of the products covered by the ascertainment for the period under review was roughly 30s. to 35s. per ton more than at the end of 1922.

Raw Iron.

Pig iron is a depressed market and several furnaces, including one in Derbyshire, have suspended operations, while the men from another furnace near Dudley have been given notice preparatory to a stoppage next week. Orders are very scarce and makers are not disposed to put their products into stock. Some concerns estimate their losses at 10s. per ton on the present selling basis. This week values are again weaker. Northamptonshire forge iron is stated to have changed hands at £4 5s. and No. 3 foundry at £4 15s. Derbyshire numbers command about £4 10s. for forge and £4 17s. 6d. for foundry. These figures are not regarded as a minimum, however. Smelters complain of their inability to get coke on the 26s. basis lately adopted by the coke makers. The explanation given is that foreign coke buying has revived, and as the fuel can be sent to European markets at much higher prices there is very little to spare for home furnaces.

Manufactured Iron.

There is a good deal of idle plant in the Staffordshire manufactured iron trade, and the lower prices recently quoted have proved no lure to consumers, who are buying to cover only their minimum requirements. Marked bars have not wavered from the £14 10s. basis which has operated since the beginning of April last, but lower-grade qualities are all cheaper. Crown bars fetch no more than £12, and in special cases a little less. For nut and bolt iron £11 seems to be the maximum, and some firms in Staffordshire are cutting even that low figure in order to induce buyers to place their orders at home. Competition is keen for the meagre amount of business available, and local makers find it very difficult to get business in face of the Belgian quotation of £9 5s. delivered in this district. Wrought iron gas tube strip has a range from £12 10s. to £12 15s.

Sheet Iron Further Advanced.

Sheet iron is once again a rising market, and the rally in galvanised sheets noted last week has been accentuated. The reduction to £17 15s. brought out a lot of new business, and the mills are now very well placed until the autumn, when the usual seasonal demand is confidently expected. This week makers have further advanced their quotations for the home trade 5s. per ton to £18 10s. and for export 10s. per ton to £18 15s. Some makers are asking as much as £19 f.o.b. Some good inquiries are being received for black sheets, and some of the local mills have quite a lot of work in hand, a number having been making full time for several weeks.

Steel.

The steel market generally tends to weakness. Low prices are heard of for tube strip, £10 10s. having been, it is stated, accepted in some instances. Staffordshire hoops are established on the reduced basis of £12 at works, but the reduction seems to have given little, if any, stimulus to buying. Small bars have a range of from £9 15s. to £10, and bedstead angles can also be bought for £10. Some steel makers have withdrawn their £7 15s. quotation for billets and are asking 2s. 6d. more. Billets can, however, be obtained at anything from £7 12s. 6d.

to £7 15s. Belgian houses have no chance with prices like these and have withdrawn from the market.

Rolling Stock Business.

The work going through the shops in the wagon building works of the Midlands has been substantially augmented by additional orders for rolling stock which have recently been secured. The volume of demand still falls short of the productive capacity of the industry; but, so far as it goes, steady employment is assured well into the autumn. Makers of rolling stock in Belgium are competing resolutely for orders, and native firms have been compelled to cut prices very finely to secure the business. Tenders have been invited, and are now in, for a considerable number of carriages and wagons, but they relate chiefly to renewals and extensions in India, South America, and other overseas railways. The uncertainty as to the course which railway enterprise at home will take remains.

Foreign Competition in Edge Tools.

Last week I recorded the fact that business in the local edge tool industry had gone rather flat again. I now learn that foreign competition from the States and from Germany has lately become more of a menace than it has been for some time. The rapid deflation of the mark is not immediately reflected in prices, but eventually it does operate in certain markets to the German's advantage. Staffordshire manufacturers are, on the whole, inclined to the view that the worst period has now been passed, and they are looking forward to a steady improvement from now onward.

LANCASHIRE.

(From our own Correspondents.)

Manchester, Thursday.

General Outlook.

The week just ended has been a very broken time in the iron and steel trades. There has been little attempt at fresh business, and in many cases, especially in the Midlands, the works have been shut down for the whole time. In the present lifeless condition of the markets people are only too glad of an excuse for inactivity. The usual markets were held in Manchester, but there was a general stagnation so far as business is concerned, although sellers did not seem inclined to make any fresh concessions in prices until they could see what the tone of business was to be when the holidays were out of the way. The general outlook does not seem to be promising, but prices all round are at or near the cost of production, and some of them below it; so that any rapid slump is scarcely to be expected. The sagging process, however, seems quite likely to go on for some time.

Metals.

The recent improvement in the metal market did not last very long, and the old feeling of depression seems to have returned again. It is difficult to see how copper can become very much cheaper than it is; but, on the other hand, consumption is greatly hampered by the present condition of Europe, and it is quite possible that the output for some months may be rather in excess of the consumption. In this case the statistics will appear to be more unfavourable; but this is not a matter of very great importance. The important thing is to get Europe back to work, and when we begin to see progress made in that direction, consumers of copper will do well to look to their stocks. Although standard and refined copper prices are now back to the lowest point of the year, there has, up to the time of writing, been no announcement as to any reduction in the prices of sheet copper, and copper and brass tubes. This, of course, may come afterwards, for with ingots quoted down to £67 10s. per ton it can scarcely be necessary to keep sheets at £100. The price charged for the Indian market, viz., £85 10s. per ton for 4ft. by 4ft. braziers, is more in accordance with the value of raw copper. The general state of demand from consumers of copper may be judged from the attitude of scrap dealers towards buying. As a rule dealers now offer only £61 per ton for good clean scrap copper and £46 per ton for good lots of scrap gun-metal. The latter is, of course, worth a great deal more intrinsically, even if it be a poor quality of metal. Tin has been rather a dull market again, and by the end of last week the greater part of the recent advance had been lost. American buyers have kept out of the market, and this seems to be the important feature at present. Of course, at any time they may come in again, and hence the situation is extremely uncertain. Experts seem to be afraid of expressing any definite opinion as to the chances of the market. The demand for lead is not very good and the price seems inclined to move downwards. This may be a result of nervousness as to whether the return of the dockers will mean a plethora of spot lead for a time. There has been, of course, a good deal of metal held up by the strike, and this has to come into the market shortly. Spelter has been a fairly steady market and the outlook cannot be considered bad. The demand from the galvanising works is better than it was.

Pig Iron.

There are no very exact indications this week as to the state of trade in Manchester. Very few business men are about and the Exchange has been largely deserted; but it may be said that the situation in the foundry iron market is no better. Cleveland iron has not yet come down to 100s., and so far as price is concerned Derbyshire iron is still the cheapest for the whole of Lancashire; but even so, it is fairly evident that the total demand is not sufficient for the Derbyshire furnaces. There is talk of blowing out one or two, but one doubts whether the price is yet low enough to compel this drastic measure. Derbyshire makers usually quote 95s. per ton on trucks, equal to about 103s. in Manchester, and one has an idea that the price is not entirely without profit. The difficulty is, of course, that they cannot sell all the output, and to stock iron at the present costs is dangerous. There are merchants here who would probably take contracts over the next two months at 100s. delivered in Manchester, and possibly some small forward business on this basis may be done next week; but as a rule consumers here are waiting for lower prices. Scotch iron is rather easier again, but hematite, delivered in Manchester, is considerably cheaper than Scotch.

Steel.

The market for finished steel is certainly easier than it was, although this week one finds it difficult to get at the lowest prices in the absence of business. Merchants are, however, offering steel joists and angles at £9 10s. per ton, and would probably accept a little less than this. Common steel plates are in poor demand and rather weak at £10 per ton.

Scrap.

The demand for scrap of all kinds does not show any improvement, but there has been no further fall in the prices. Scrap is comparatively cheap and is a safer material to hold than either pig iron or semi-steel. Dealers here are quoting 80s. per ton for ordinary lots of cast iron scrap and 85s. for special lots. The malleable ironworks in Lancashire are paying 75s. per ton for heavy wrought scrap and the steel works in Sheffield offer 70s. per ton for heavy steel melting scrap. One does not see that the prices have much room in which to fall.

Barrow-in-Furness, Thursday.

Hematites.

The production of hematite pig iron has got down to a low level in North Lancashire and Cumberland, where there are now only thirteen furnaces in blast, including a small furnace on charcoal blast. The normal number is twenty-five or a shade higher. Stores of iron have been run up by some makers, but it is expected that there will be no further cut in output. Business this week is interfered with on account of the holidays, as is usually the case. The attitude of users is only to place orders to cover their immediate requirements, and although reductions have been made in price there is no disposition to order to any extent. Local wants are pretty well maintained and iron for America is being made. Special and charcoal iron are only limited trades.

Iron Ore.

For hematite iron ore the demand is almost wholly a local one. At most of the pits short time is being worked and the Hodbarrow mines are entirely closed down. Spanish ores are in quiet demand and a fair tonnage is stored on the Barrow Docks.

Steel.

At both Barrow and Workington steel output is being interfered with on account of the holidays. Orders are held for rails, hoops, sections, tires, and axles, but new business is small all round. From Barrow a fairly good tonnage of steel rails has been dispatched overseas.

Shipbuilding and Engineering.

These trades are this week observing their annual holiday.

Fuel.

For steam coal there is a quiet demand and East Coast coke is in easy request.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

The condition of the steel trade in this district has not altered much since my last report, and what change there is can hardly be described as being for the better. The holiday lull was not a long one, most of the works reopening on Tuesday, but in many cases the re-start was only of a partial character. The falling off in orders for mild steel and finished products has been accentuated by the holiday season, and new business is coming in very slowly. The recent reductions in steel prices have not stimulated the demand much. The crucible steel and high-speed steel branches are still, generally speaking, in a very depressed condition, although here and there firms can be found which are fairly well placed. The edge tool trade continues to be one of the most active departments on the lighter side.

More Railway Work Expected.

In heavy manufactured steel, those plants devoted to the manufacture of railway requirements are still among the busiest, and they look forward confidently to a continuance of work. The official journal of the Sheffield Chamber of Commerce, in its last issue, states that "railway orders broaden out only slowly, but we know for a fact that the companies have heavy programmes on hand which will call for corresponding quantities of Sheffield and Rotherham products, from rails and fish-plates to carriages and general furnishings. I have been privileged to examine the details of one big programme. Even already our local makers of railway material are operating quite up to their best pre-war level, though, of course, this is not enough, and the trade is yielding little profit, whilst the burden of rates and taxes remains preposterous and almost ruinous, and fuel costs are also much too high. In addition to the numerous railway extensions which are going forward in this country and in India, there are many large schemes in other parts, especially South America, which should bring work to Sheffield. The Government of the Argentine has voted about £25,000,000 for State railway constructions and renewals over the next three years; Peru is planning the construction of a big line with many spurs; Bolivia is considering plans for a line to connect Santa Cruz de la Siera with Cochabamba, and is co-operating with the Argentine for a big inter-State system; while Brazil will be a huge market for railway materials for many years to come.

Cutlery and Plate.

A cheering item of news this week is that one firm in the city has just booked an order for spoons and forks to the value of £22,000, and the work will keep this establishment busy for a considerable time. This, however, is one of the few bright spots in the situation. Generally speaking, the cutlery and plate trades are very dull. For the last two or three months the position has been unsatisfactory and the demand shows no improvement, but fluctuates within narrow limits. The home market is making very small calls upon the manufacturers, even for stainless knives, which have for long been the busiest of all cutlery lines. The quantity of business coming forward from Canada, South Africa and South America is anything but good. A better state of things is reported with regard to Australia, but even there the demand is not quite so keen as it was at the beginning of the year. The silver and electro-plate trades give a similar account of their state. Orders from the home market are few and difficult to obtain, while overseas requirements are, in the main, for the cheapest qualities.

A Railway Concession.

Some satisfaction has been caused in trading circles by the railway concessions just announced, and especially by the action of the London, Midland and Scottish Railway Company in putting the reductions into operation at once. The reduction of charges from 60 to 50 per cent. above pre-war standard is a valuable one. One rather important point is that there will be a decrease of from 1d. to 2d. per ton on the cost of coal coming into Sheffield from the immediate neighbourhood, and although this looks but trivial as a matter of detail, it will mean a considerable saving to the firms in the aggregate. All the same, those concerned would have preferred that the railway companies had done away with the flat rate of 2d. per ton on coal and coke, and 3d. or 4d. a ton on most other things that directly affect Sheffield.

Government's Unsatisfactory Offer.

A good deal of disappointment is felt with the terms of the Government's offer to assist necessitous areas. As I have several times mentioned, Sheffield maintains that its present heavy burden of unemployment is largely due to the way in which strangers were attracted to the city during the war, when it was working night and day to meet the needs of the fighting forces. The city considers, therefore, that it has a strong claim to definite national help in bearing the load of debt which it has had to pile up in order to meet the heavy calls for poor law relief. The Government, however, only offers to advance such a sum as would reduce the poor rate—at present 10s. 6d. in the £—to a stabilised amount. The interest on this loan is to be suspended, but there is no definite promise that it will not be called for at a future date. The offer is regarded as very inadequate, and the City Council has passed a strong resolution of protest.

New Grinding Regulations.

The statement of the Home Secretary, in the House of Commons last week, that he would have to strengthen and extend the existing regulations on the grinding of metals and cleaning of castings has a very direct interest for Sheffield, as the report by two of the Factories Inspectors, out of which the proposed amendments will arise, was largely based on evidence of Sheffield conditions. Regulations were made some years ago, under which dust exhaust appliances are fitted in many grinding shops, but the Inspectors complain not only that many of the existing plants fail to fulfil their function, but also that the regulations are inadequate by reason of their limitation to dry grinding. The report is emphatic that the prevalent belief that dust is not generated by wet grinding as ordinarily carried on is erroneous. It states that localised exhaust has not proved applicable to wet sandstone grinding, and the usual method of keeping a grindstone wet by running it in contact with water in a trough is unsatisfactory and harmful. Among the new regulations proposed are "that no racing, dry grinding, or glazing, causing the evolution of dust, shall be done without a hood, an air-tight duct, and a fan or other efficient means of producing a draught, nor any wet grinding without a supply of clean water conveyed by pipes laid on the surface of the grindstone and drained from the grindstone trough." The report also declares that in many cases, particularly in the Sheffield tenement factories, the structural conditions are prejudicial to health and safety, and need overhauling.

An Ironworks Transfer.

It is announced that the purchase of the Normanby Ironworks Company has now been completed by Pease and Partners, Limited. The latter firm has been in full control of the works since 1911, but by the terms of the agreement it was not required to complete the purchase until the years 1923 and 1932.

Public Schemes.

Sheffield City Council has in view various schemes of public utility which are to be put in hand for the purpose of finding work for the unemployed, and the total cost of which is about £600,000. Detailed proposals for the first portion of these have now been adopted. This instalment of the schemes will cost £332,539 and will provide work for 1600 men for periods ranging from two to eighteen months. The Council is also pushing on with its housing schemes, each instalment consisting of 150 houses. The Buxton Town Council is building twenty-six houses at a cost of £13,240. In passing it may be remarked that at Buxton, too, there has been a reduction of 2d. per 1000ft. in the price of gas, making the existing charges as under:—3s. 9d. for lighting, 3s. 6d. for heating and

cooking, by separate meter, and 3s. 3d. for gas engines. The Nottinghamshire County Council is to carry out improvement schemes on many miles of main roads in the county, the work involving an estimated expenditure of £24,350.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Conditions.

There are few encouraging features in the trade position in the North of England, but some hope is expressed that the worst of the depression has been experienced. It cannot be denied, however, that the general condition is still very disappointing, little movement having as yet been made in the direction of arranging for autumn work, negotiations for which usually commence about this period of the year. The whole trade situation seems to hang more or less on the French occupation of the Ruhr, and until there is some improvement there, trade is not likely to improve to any great extent. The fact that three hematite furnaces are being put out of operation is an indication of the state of affairs in the iron trade. This makes five furnaces which have been stopped since the beginning of June, and there are now only forty-three blast-furnaces producing iron on the North-East Coast.

Cleveland Iron Trade.

Business in the Cleveland pig iron trade is very quiet. What inquiries are circulating do not result in business of any great moment, and as producers are well through contracts in hand they feel some apprehension as regards the future. Buyers are most cautious in their dealings, and as they are disinclined to purchase more than essential early needs, demand transactions are mostly of a hand-to-mouth kind. Under such circumstances prices all round are inclined to further weakness. No. 1 is no more than 110s., No. 3 G.M.B. 102s. 6d., and No. 4 foundry and No. 4 forge each 97s. 6d.

Hematite Pig Iron.

There is very little demand for hematite pig iron on home or export account, and the steel makers in particular are using very much less iron. Mixed numbers can now be purchased at 97s. 6d. per ton.

Ironmaking Materials.

The foreign ore trade is still quiet, with best Rubio ore put nominally at 23s. per ton c.i.f. Tees. Durham coke makers still quote 41s. to 41s. 6d. per ton for good furnace coke, although the fewer furnaces in blast may ease the position with regard to supplies.

Manufactured Iron and Steel.

Competition for orders in the various branches of the iron and steel trade is exceedingly keen. Continental producers are reported to be still booking forward contracts, though the margin that has existed between their prices and quotations here has diminished. Several firms abroad, it is stated, are disinclined to take on more work under existing conditions, and the withdrawal of continental competition from the world's markets, even if only temporary, should divert orders to this country. There is an increased inquiry from overseas, but actual business is slow. Quotations are unchanged.

Iron and Steel Exports.

Iron and steel exports from the Cleveland district during July showed a gratifying improvement, the total for the month being returned at 80,539 tons, as compared with 77,588 tons in June. The shipments of pig iron reached 36,370 tons, as against 25,829 tons, and despite the ridiculous position of the mark, Germany was the largest customer, taking 15,875 tons. The other principal customers were the United States, with 2200 tons; Wales, 3950 tons; Denmark, 1594 tons; and Belgium, 2187 tons. The exports of manufactured iron and steel totalled 44,169 tons, as compared with 51,759 tons in June. India took 11,407 tons; Egypt, 6034 tons; Victoria, 3126 tons; Natal, 2978 tons; and New South Wales, 2187 tons.

The Coal Trade.

The Northern coal trade position is entirely unimproved, and the indications observable seem to point to the present dulness and weakness continuing for some little time to come. There is as yet no halt called to the falling tendencies of the quotations. The position is, in fact, assuming more or less a menacing aspect, and many of the large holders are becoming more than a little anxious as to the further trend of affairs. Some of them are decidedly of the opinion that the worst has been reached and some improvement may be looked for in the near future; but others are apparently convinced that prices will go lower, and, acting in harmony with that idea, are rushing their supplies forward for clearance at discounted prices. It is asserted that the economic bedrock of profitably working the collieries has been reached, and some of them are facing actual loss if the downward trend of prices is not arrested. The volume of business under discussion is exceedingly small. The home demand has dwindled considerably and there is absolutely no improvement in the inquiry from abroad. Whatever orders are put into circulation for competition just now seem very seldom to mature. Quotations are either sent back with a ridiculous counter-offer attached, or are not heard of again. Moreover, many of the exporters are inclined to be more and more pessimistic about their clients abroad taking the quantities already contracted for. It is quite a common experience for them to receive either cancelments or requests to postpone shipments until later on. Next to nothing is being sold to France, Belgium, Germany or Scandinavia. The Northumberland steam coal section is dull and disappointing, and for any best screened coals concessions can be exacted, which applies equally to secondary screened sorts, though small steams keep moderately steady. For gas, coking, or bunkers there is only a very poor market, and though some of the favoured brands are fairly comfortable, most of the collieries are having a bad time and are prepared to give good concessions for prompt trade. The coke market remains generally steady for all foundry sorts, but gas coke is a shade easier in price.

SCOTLAND.

(From our own Correspondent.)

Slow Progress.

Industrial conditions continue about the same. Any progress towards an improvement in trade in general is extremely slow, and in fact is barely noticeable. Various industries are still in the midst of disputes with regard to time and wages, and others are on the border line of similar trouble. Under such circumstances it is hardly possible to look for any improvement in trade, and all industries are suffering together. The craze for shorter hours and a minimum wage without guarantee of output is having its day, and until it passes the outlook must be problematical. Many craftsmen are leaving this district for other countries in which higher wages can be earned with a much longer working week, and appear quite content with the prospect. It seems quite feasible that these workers would be quite content to have the same chance in their own country, but are not content, or perhaps cannot afford, to wait until their fellow-workers or their respective trade unions see the real point of the situation. That short hours, a minimum wage and indifferent production can produce anything other than a poor standard of efficiency is not a reality, but a dream, and until the fallacy is exposed to the workers progress is bound to be slow. Not only so, but the country must lose many who realise that "time is money" has a personal significance. Meanwhile we are in the throes of industrial controversies and disputes which, unless used as a medium to promote a better feeling between the employer and the worker, can mean nothing else but increased loss all round.

Pig Iron.

The position in the pig iron trade is most unsatisfactory. Makers are doing their utmost to keep a certain number of furnaces in operation, but with supplies greater than the demand some curtailment must soon be made. Hematite is still quoted at £5 16s. 3d. per ton, No. 1 foundry £5 10s., and No. 3 foundry £5 5s.; but in the case of the last two it is likely that something less would be acceptable for a favourable order. Home demands are very weak and export orders are only very occasional.

Steel and Iron.

Reports from the various districts are not very encouraging. Works have re-started, but in most cases only a small portion of the plants are in operation. Specifications for plates and sectional steel are still conspicuous by their absence, and there seems little chance of any development until the shipbuilding industry revives. Sheet makers have secured a fair number of orders for light-gauge material for export. Galvanised sheets, too, show a little more activity and a slightly firmer tone. The bar iron works have only partially resumed operations. Here again the overseas demand is better than the home one, but that does not mean much. Practically the only branch of the steel and iron industries to show any real activity is the structural steel department. Some firms, it is said, have enough work to secure employment for a year at least, and more good contracts are in prospect. Prices generally are untested and unchanged.

Coal—Heavy Demand for Washed Nuts.

The feature of the coal trade has been the continued demand for washed materials for export. All nuts, but more especially doubles and singles, have heavy bookings and are not now easily obtained. Prices therefore are strongly maintained and some high figures have been paid. Round fuel, on the other hand, has been slow to move and undercutting has been indulged in. Forward inquiries are more promising, however. Aggregate shipments for the week amounted to 305,285 tons, against 267,359 tons in the preceding week and 298,070 tons in the same week last year. The Firth of Forth ports have been especially busy, and the bulk of the coal dispatched went to Germany, Belgium, and near continental destinations. The home market is idle, neither industrial nor household requirements being of much account.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

It will be next week at the earliest before business settles down in the coal export trade, for the reason that supplies will be scarce, as the result of the holidays. Three days' holiday means that there will be no coal coming down from the collieries until Thursday night, and even then the prospects are, that less than the usual quantity will be available, as the fine weather will undoubtedly induce many miners to extend their leave. At the moment of writing the majority of the workmen are on the move holiday making, and it looks very much as if little more than a third of the usual week's output can reasonably be expected this week. This is a considerable loss in view of the tonnage already in dock waiting to load. Quite a good number of steamers managed to complete their cargoes and sail before the vacation, but the total of those which were less fortunate and the fresh arrivals during the holidays means that collieries will have a plentiful supply for this week and next. The extreme scarcity of coals will result in very little new business for early shipment being negotiated, for the reason that colliery salesmen will be reluctant to enter into fresh transactions while they have commitments which will keep them busy for the next week or two. There were indications of a better inquiry from abroad immediately before the vacation, though the prices offering were rather on the low side. In most cases the demand was for cargoes of superior qualities for this month's shipment, but there are very few exporters in the position to accept such business, and so far as most of the collieries are concerned, those producing the better classes of coals are so well sold that they cannot undertake further obligations for August. In some instances, seeing that the coals are not obtainable for this month's loading, buyers are inquiring for quotations for September, but colliery owners are not disposed to sell ahead unless they can secure an improvement upon the prices now ruling. At the moment collieries will entertain 32s. 6d. for best Admiralty large and 30s. for second qualities for supplies for delivery over the remainder of this year, but buyers are not prepared to do business on this basis at the present time.

Grain-handling Plant.

The Great Western Railway Company is evidently bent on effecting as much improvement as possible at South Wales ports in order to facilitate trade, and the directors have now decided to provide floating pneumatic grain-handling plant at Cardiff, capable of discharging grain from ship to shore at a maximum rate of 120-130 tons per hour.

Third Shift Advantage.

So far nothing has been made public concerning the outcome of the visit of representatives of the tippers to London last week to interview headquarters of the N.U.R. regarding their move to bring about the termination of the working of the third shift. It is questionable whether the delegates will get much, if any, sympathy, as the N.U.R. headquarters had previously rejected the proposal of the men to end the third shift. Headquarters were aware that an agreement had been come to that the working of the third shift was for an experimental period of six months, and this being the case, they favoured sticking to the agreement. Many instances can be mentioned of the advantage of the third shift in expediting the loading and sailing of tonnage, and a case occurred last week. The ss. Sturdee Rose arrived at the Barry Docks at 3.20 on Friday afternoon, got under a tip an hour later and sailed at 3 a.m. on Saturday with 1005 tons of coal for Dieppe. If the third shift had not been working it is practically certain that the vessel would not have been able to complete loading to sail on the Saturday, and would therefore have been detained until after the holidays, viz., until Wednesday, at a cost of about £25 per day.

Current Business.

Business has been at a standstill since last week, and it will be next week before there is anything like a resumption of operations. Coals are scarce as the result of the holidays, and colliery salesmen are reluctant to consider new business until they can see their position better as regards the obligations they are already under. There is no doubt that so far as the superior coals are concerned their position is pretty strong, as before the holidays it was known that they were very fully sold for the whole of this month. For the time being the market is quiet and under holiday influences, and in the circumstances prices must be taken as more nominal than anything else.

Catalogues.

Hick, Hargreaves and Co., Limited, Bolton.—Catalogue. Uniflow steam engines.

Joseph Kaye and Sons, Limited, Lock Works, Leeds.—Catalogue. Kaye's oil cans.

R. Jenkins and Co., Limited, Rotherham.—Pamphlet. "Welding Makes a Better Job."

Davidson and Co., Limited, Belfast.—Catalogue No. 1. "Sirocco" mine fans. Catalogue No. 2. "Sirocco" air washers.

Beldam Packing and Rubber Company, Limited, 29, Gracechurch-street, E.C. 3.—Catalogue of the firm's manufactures.

Dickinson and Burne, Limited, Lochlands Works, Arbroath.—Catalogue. Vertical enclosed, double-acting, force-lubricated steam engines.

Coventry Chain Company, Limited, Coventry.—Brochure. Textile machinery. Catalogue C 22. "The Coventry" high-precision, high-duty transmission chains.

Empire Roller Bearings Company (1923), Limited, Empire Works, Thornbury, Bradford.—Catalogue. Empire roller bearings for power transmission, rolling stock, &c.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are informed that the business of Fortis and Partners, of 66, Victoria-street, Westminster, S.W. 1, has been acquired by the Low Engineering Company, Limited, and that Mr. H. S. O'Brien (late of Vickers Limited) is remaining with the company.

We are asked to state that Mr. A. H. Jackson has resigned his position as traction representative to the English Electric Company, Limited, on being appointed sales manager of the Electric Traction Department of the General Electric Company, Limited, Magnet House, Kingsway.

Mr. Guy F. Dowding has resigned his position as London sales representative of the Sheffield Twist Drill and Steel Company, Limited, the London business of which is now being entirely transferred to the firm's own London office, Mansion House Chambers, 11, Queen Victoria-street, E.C., to which correspondence should in future be addressed.

We are informed that Dr. Percy Longmuir, the Director of Research to the British Cast Iron Research Association, has had to resign his post owing to a breakdown in health, but will continue in office until next November. The Council are taking steps at once to appoint a successor to Dr. Longmuir, so that the research work now being carried out can be continued without a break. Before Dr. Longmuir finally retires he proposes to issue the Bulletins detailing the research work he has carried out.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	26/-
(1) Spanish	24/-
(1) N. African	24/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	23/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	5 12 6	—
No. 1 Foundry	5 10 0	—
No. 3 Foundry	5 5 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 19 0	4 19 0
No. 1	5 0 0	5 0 0
Cleveland—		
No. 1	5 10 0	5 10 0
Silicious Iron	5 7 6	5 7 6
No. 3 G.M.B.	5 2 6	5 2 6
No. 4 Foundry	4 17 6	4 17 6
No. 4 Forge	4 16 0	4 16 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	13 0 0	—
North Staffs. Forge*	—	—
„ „ Foundry	5 0 0 to 5 2 6	
(3) Northampton—		
Foundry No. 3	4 15 0 to 4 16 0	
„ Forge	4 5 0 to 4 7 6	
(3) Derbyshire—		
No. 3 Foundry	4 15 0	—
Forge	4 10 0	—
(3) Lincolnshire—		
Basic	5 5 0	—
Foundry	4 15 0	—
Forge	4 15 0	—
(4) N.W. Coast—		
N. Lancs and Cum.—		
Hematite Mixed Nos.	5 17 6†	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Crown Bars	12 0 0	—
Tees	10 0 0	—
Lancs.—		
Crown Bars	12 0 0	—
Second Quality Bars	11 5 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	12 10 0	—
Best „	13 10 0	—
Hoops	15 10 0	—
Midlands—		
Crown Bars	12 0 0 to 12 10 0	
Marked Bars (Staffs.)	14 10 0	—
Nut and Bolt Bars	11 0 0 to 11 5 0	
Gas Tube Strip	12 10 0 to 13 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¼in. and up	10 0 0	—
Sections	9 15 0	—
Steel Sheets, 3/16in. to ¼in.	12 10 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 17 6

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	10 0 0	—
Angles	9 10 0	—
Boiler Plates	14 0 0	—
Joists	9 15 0	—
Heavy Rails	10 0 0	—
Fish-plates	14 0 0	—
Channels	9 5 0	—
Hard Billets	10 5 0	—
Soft Billets	9 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 10 0†	—
Light „	11 0 0†	—
Billets	10 0 0†	—
Manchester—		
Bars (Round)	11 0 0 to 11 5 0	
„ (others)	10 0 0 to 10 2 6	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	
„ (Lancs. Boiler)	13 10 0	—
Sheffield—		
Siemens Acid Billets	12 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	10 5 0	—
Intermediate Basic	10 0 0	—
Soft Basic	8 10 0	—
Hoops	12 15 0 to 13 5 0	
Soft Wire Rods	13 0 0	—
Midlands—		
Small Rolled Bars	9 15 0 to 10 0 0	
Billets and Sheet-bars	7 15 0 to 8 5 0	
Gas Tube Strip	11 0 0 to 11 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	18 10 0 to 19 0 0	
Angles	9 15 0	—
Joists	9 15 0	—
Tees	10 15 0	—
Bridge and Tank Plates	10 5 0 to 10 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/1½
Block Tin (cash)	194 15 0
„ (three months)	185 10 0
Copper (cash)	85 5 0
„ (three months)	66 0 0
Spanish Lead (cash)	24 7 6
„ (three months)	24 10 0
Spelter (cash)	31 15 0
„ (three months)	31 10 0
Manchester—	
Copper, Best Selected Ingots	69 0 0
„ Electrolytic	72 0 0
„ Strong Sheets	100 0 0
„ Loco. Tubes	0 1 1½
Brass Loco. Tubes	0 1 0
„ Condenser	0 1 2½
Lead, English	25 5 0
„ Foreign	24 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11 per lb.	
Ferro Tungsten	1/5½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	10/6
„ 6 p.c. to 8 p.c. „	£21 0 0	8/-
„ 8 p.c. to 10 p.c. „	£20 0 0	8/-
„ Specially Refined		
„ Max. 2 p.c. carbon	£50 0 0	18/-
„ „ 1 p.c. „	£60 0 0	21/-
„ „ 0.75 p.c. carbon	£70 0 0	22/6
„ carbon free	1/6 per lb.	
Metallic Chromium	4/6 per lb.	
Ferro Manganese (per ton)	£18 for home, £20 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 0 0	scale 5/- per unit
„ „ 75 p.c.	£21 0 0	scale 6/- per unit
„ Vanadium	16/9 per lb.	
„ Molybdenum	9/6 per lb.	
„ Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£130	
Cobalt	12/- per lb.	
Aluminium (per ton)	£82 to £100	

(British Official.)

FUELS.

	Inland.	Export.
Scotland.		
Lanarkshire—		
(f.o.b. Glasgow)—Steam		20/-
„ „ Ell		21/6
„ „ Splint		22/6 to 23/6
„ „ Trebles		25/6
„ „ Doubles		24/6
„ „ Singles		23/6
Ayrshire—		
(f.o.b. Ports)—Steam		20/-
„ „ Splint		22/6
„ „ Trebles		25/6
Fifeshire—		
(f.o.b. Methil or Burntisland)—Steam		21/6 to 23/6
Screened Navigation		29/-
Trebles		26/6
Doubles		25/-
Singles		24/3
Lothians—		
(f.o.b. Leith)—Best Steam		21/6
Secondary Steam		20/6
Trebles		26/-
Doubles		25/-
Singles		24/-
England.		
(8) N.W. Coast—		
Steams		31/6
Household		46/8 to 57/6
Coke		48/-
Northumberland—		
Best Steams		24/- to 26/-
Second Steams		23/ to 24/-
Steam Smalls		15/6 to 17/-
Unscreened		20/6
Household		25/- to 28/-
Durham—		
Best Gas		26/6 to 27/-
Second		22/6 to 24/-
Household		25/- to 28/-
Foundry Coke		60/- to 62/6
Sheffield	Inland.	
Best Hand-picked Branch	32/6 to 34/6	—
Barnsley Best Silkstone	26/6 to 28/-	—
Derbyshire Best Brights	25/- to 27/-	—
„ „ House	22/6 to 23/6	—
„ „ Large Nuts	20/- to 21/6	—
„ „ Small „	15/- to 16/-	—
Yorkshire Hards	21/- to 23/-	—
Derbyshire „	20/- to 22/-	—
Rough Slacks	11/6 to 13/6	—
Nutty „	10/- to 12/-	—
Smalls	7/- to 9/-	—
Blast-furnace Coke (Inland)	32/- to 33/-	
„ „ (Export)	f.o.b.	44/- to 45/-
Cardiff—	(9) South Wales.	
Steam Coals:		
Best Smokeless Large		30/- to 32/-
Second „		28/6 to 30/-
Best Dry Large		29/- to 30/-
Ordinary Dry Large		27/- to 29/-
Best Black Vein Large		28/6 to 29/6
Western Valley „		27/6 to 28/6
Best Eastern Valley Large		27/- to 28/-
Ordinary „ „		26/- to 27/-
Best Steam Smalls		21/- to 22/-
Ordinary „		19/- to 21/-
Washed Nuts		30/- to 32/6
No. 3 Rhondda Large		32/- to 33/-
„ „ Smalls		25/- to 26/-
No. 2 „ Large		24/- to 25/-
„ „ Through		22/6 to 23/-
„ „ Smalls		16/- to 17/-
Coke (export)		55/- to 62/6
Patent Fuel		32/- to 34/-
Pitwood (ex ship)		33/- to 32/6
Swansea—		
Anthracite Coals:		
Best Big Vein Large		50/- to 52/6
Seconds		42/6 to 45/-
Red Vein		30/- to 32/6
Machine-made Cobbles		62/6 to 65/-
Nuts		62/6 to 65/-
Beans		45/- to 47/6
Peas		25/- to 27/6
Breaker Duff		12/6 to 13/-
Rubbly Culm		15/- to 16/-
Steam Coals:		
Large		26/- to 27/6
Seconds		23/6 to 26/-
Smalls		18/- to 22/-
Cargo Through		22/6 to 25/-

(1) Delivered. (2) Net Makers' works. (3) At furnaces. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow.

(8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b.

* Quotations extremely high and nominal. † Latest quotations available.

French Engineering Notes.

(From our Correspondent in Paris.)

The Ruhr Stocks.

During the occupation of the Ruhr the French authorities have seized very large quantities of rolled iron and steel and other metallurgical products, which they hardly know how to dispose of for fear of arousing opposition from French iron and steel firms. It is believed that if the material were thrown upon the market it would seriously affect the position of mill and forge owners who have been steadily increasing their production during the past two months. At the same time, the higher values of coke and other raw material and the increasing wages have augmented production costs to the extent that a further rise in prices is anticipated next month, and it is evident that if the Ruhr stocks are put upon the market indiscriminately the home iron and steel firms may find themselves in an embarrassing situation. An announcement last week that some of the Ruhr stocks would be offered for sale in the devastated regions under special conditions aroused so much protest that the Government has found it necessary to constitute an interministerial commission, composed of representatives of the Government and of the metallurgical industries, to decide upon a method of disposing of the stocks without jeopardising the situation of iron and steel firms. The quantity of material seized in the Ruhr is evidently considerable, although no indications are given of the approximate amount.

High-compression Engines.

The various devices proposed for insuring engine efficiency at high altitudes are intended to give the practical result of permitting aeroplanes to travel at considerable speeds in the rarefied atmosphere. As speed is a factor in economy it is hoped by this means to ensure air transport over long distances at low cost. The first attempt was made with the turbo-compressor of Professor Rateau, which ensured a definite proportion of air to petrol irrespective of the density of the atmosphere. Still more encouraging results are now being obtained with the use of high-compression engines, whereby alcohol and similar fuels that are not susceptible to self-ignition are employed under normal conditions of atmospheric density, and petrol is used at high altitudes where the quantity of air is reduced to an extent that the petrol fuel works at a normal compression. This necessitates carburetter adjustments to which special attention is now being given by makers of such apparatus. The method of starting on a fuel capable of high compression, and of turning on to petrol at high altitudes, was employed by Sadi Lecointe last week, when he broke the record by attaining a height of 10,800 m.

Wagons.

So unsatisfactory is the situation of wagon builders that the Conseil Supérieur des Chemins de Fer is asking the railway companies to place orders for their requirements in rolling stock during the next three years. It is feared that those requirements will not be large, but it is hoped that they will have the effect of giving a certain stability to this department of the engineering industry. The immediate result of the negotiations has been the distribution of orders for a thousand wagons by the Nord and the Est. The requirements are considerably restricted by the huge number of German wagons which are constantly being repaired, and it is certain that the service on some of the lines would gain in efficiency if much of the existing rolling stock could be replaced by new wagons, for which reason there was at one time a strong agitation in favour of selling the surrendered German vehicles abroad. The situation is regarded with increasing disfavour in view of the total lack of orders from Poland. While France has been furnishing that country with the capital and credits necessary for reconstruction work, the requirements in wagons for the Polish railways have been supplied entirely by other countries; for instance, the United States, which is delivering to Poland 7500 30-ton trucks. Altogether Poland will be receiving shortly more than 21,000 wagons, of which not a single one is being supplied by French builders.

The Canadian Exhibition.

The travelling exhibition of Canadian products, which started from Havre and is now touring the north and east of France before making a long stay in Paris, and then continuing through the southern departments, appears likely to promote considerably the commercial relations between the two countries. At all the towns the members of the mission, with their 32 tractors and vehicles, have had a cordial reception, and while the Canadian Exhibition has awakened great interest, some of the industrial towns arranged a display of local products for the benefit of the mission, which has been afforded every opportunity of investigating French agricultural and industrial resources.

Road Depreciation.

The cost of road maintenance in Paris on account of wear and tear due to the increasingly heavy traffic of motor omnibuses and other big vehicles is becoming so serious a matter that a commission of the Municipal Council has reported upon the desirability of rendering compulsory the use of pneumatic tires. The Commission argues that the Paris streets are so honeycombed with mains that the surface is liable to intense vibration with the running of heavy vehicles on solid rubber tires, and that no sooner are the roads relaid than they begin to show signs of some sort of disintegration. It is, therefore, suggested that this difficulty might be overcome by the passing of a law to make the use of pneumatic tires compulsory. Obviously, it must first be ascertained whether such tires are practicable for very heavy loads, and doubtless some valuable data will be available as the result of the trials with pneumatic tires that have been carried out for a long while past by the Paris Omnibus Company.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

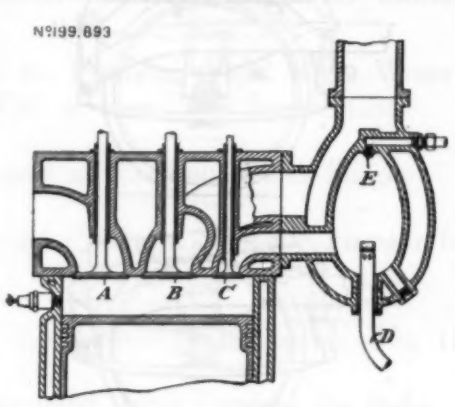
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

199,893. May 11th, 1922.—Fuel Mixtures, H. R. Ricardo, 21, Suffolk-street, Pall Mall, London, S.W. 1.

The inventor proposes to make an internal combustion engine more "flexible" by providing it with mixtures of hydrogen gas and ordinary fuel. The hydrogen is supplied in such quantities that it is just sufficient to keep the engine running on light load,

N°199,893



and the hydro-carbon fuel is added according to the load on the engine. A is the air inlet valve, B the exhaust, and C the inlet valve for the fuel. The hydrogen is supplied by the pipe D and the other fuel at the jet E. The two fuels are mixed in a chamber jacketed by the exhaust gases.—*July 5th*, 1923.

CONDENSERS AND FEED-WATER HEATERS.

199,907. May 18th, 1922.—Economisers, A. Descy, 3, Rue St. Hubert, Ciney, Belgium, L. Simon, 24, Rue Liervenne, Ciney, and Société Anonyme des Fonderies et Distributions d'Eau à Ciney.

In this economiser ordinary parallel force-fit joints are used for connecting the tubes with the headers, but the top joints A

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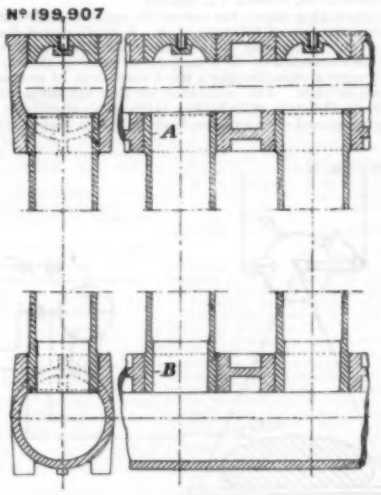


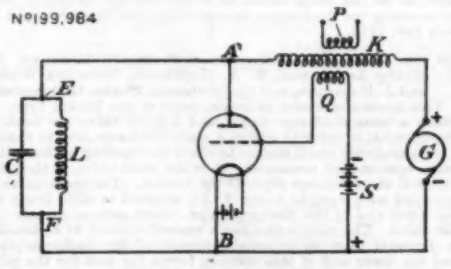
are larger in diameter than the bottom joints B. It is thus possible, in the event of a tube failing, to insert a new one from the top.—*July 5th*, 1923.

TELEGRAPHS AND TELEPHONES.

199,964. July 17th, 1922.—Improvements in and relating to the Method of and means for Generating and Amplifying Electrical Oscillations by Thermionic Tubes, Lionel George Preston and Newton Shuttleworth, of H.M. Signal School, Royal Naval Barracks, Portsmouth.

According to this invention, a system or arrangement of circuit

N°199,964

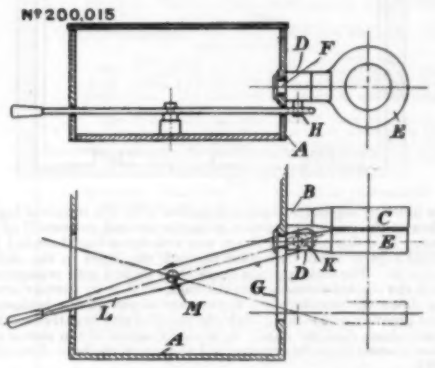


is devised whereby small alternating currents of any frequency are amplified, or alternating currents of any frequency are generated, by the employment of electro-magnetically coupled circuits, which are directly independent of the main generated current or the resultant amplified current. Such a system or arrangement is particularly applicable to wireless telegraphy or telephony. The alternating current to be amplified is taken to the primary coil P of a transformer, the ratio of the transformation being as high as is practically possible. The current oscillation in the secondary coil K of the transformer or of a coil K coupled to the primary winding P is transformed to a minute value or to as negligibly small a secondary current and as high a voltage oscillation as is practically possible. This is done by means of coupling a coil K having a large number of turns to the primary coil P. The coil K is shown inserted between the anode of the thermionic tube A and the generator G. The anode of the tube A is also connected to the tuned circuit E F, comprising the condenser C and inductance L. The battery S is included with the coil Q in the grid filament circuit of the tube A. The voltage pulsation is utilised to obtain an amplified current in a separate circuit E, F preferably tuned to the frequency of the incoming current. The tuned or oscillatory circuit E F is connected across the anode and filament of the triode thermionic tube, and also across the coil K in series with a generator G or other source of high-tension direct current. The apparatus is applicable to the generation of continuous waves for transmitters or receivers, and to relays for wireless or wired telegraphy or telephony.—*March 23rd*, 1923.

200,015. October 25th, 1922.—Improvements in Coil Holders for Wireless Apparatus, Harry Saville, of 1, Delamere-avenue, Stretford, near Manchester, and Charles Henry Thornton, of 18, Melbourne-avenue, Stretford.

The coil holder described in this specification is intended for honeycomb, duolateral and other coils used in wireless apparatus. A represents the box, panel or other part, to which is fixed the usual construction of coil base B, capable of receiving the duolateral or other coil C. A similar base D and coil E are pro-

N°200,015



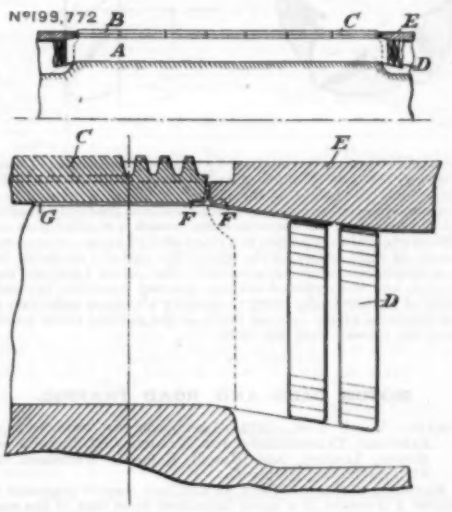
vided, as in ordinary practice. A projecting piece F from the base of D slides in the slot G, while a projecting piece H works in the slot K formed in the lever L, which is pivoted at the fixed point M. It will be apparent that the movement of the lever will give movement to the coil E parallel with the fixed coil C.—*July 5th*, 1923.

DYNAMOS AND MOTORS.

199,772. March 3rd, 1922.—Improvements in and relating to Dynamo-electric Machines, Sir Charles Algernon Parsons and Jessel Rosen, both of Heaton Works, Newcastle-on-Tyne.

It is found in practice that the eddy currents induced in the rotor of dynamo-electric machines can be readily carried by the rotor body and by the keys securing the exciting windings in position, and also that these induced currents can be readily carried by the end caps, which support the ends of the exciting windings where they project beyond the rotor body. Difficulty is experienced, however, in transmitting these currents across the gap between the cap and the body, and the invention relates more particularly to improvements in the means for overcoming this difficulty. The exciting coils A are arranged on the rotor, in slots, running parallel to the axis, and are held in position by

N°199,772



keys in short lengths B C forced into grooves in the rotor body. Where the exciting coils overhang at D as they bend round to a neighbouring slot, they are supported in the well-known manner against centrifugal force by an annular cap E, which butts against or is in close contact with the end lengths C of the keys. For constructional reasons, it is desirable to provide both the cap E and the lengths of key C with an internal radius F, thus leaving a space, and in order to carry the induced currents across this space without local heating, the bonding strip G is specially shaped to fill it, thereby locally providing increased contact surface and a large cross section of high conductivity metal to carry the induced currents between the caps and the rotor body.—*July 3rd*, 1923.

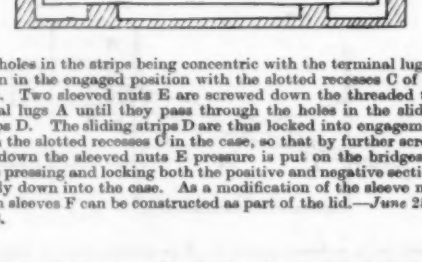
BATTERIES AND ACCUMULATORS.

199,785. March 24th, 1922.—Improved Method of Constructing an Electric Accumulator, Alfred Henry Culley, of 68, Francis-road, Erdington, Birmingham, and Leslie Mott, of 154, Great Colmore-street, Edgbaston, Birmingham.

The positive and negative plates are secured to the bridges

of the accumulator in the usual way. The bridges are made wider than usual, being just a sliding fit into the ends of the case. From the bridges the terminal lugs A pass up through holes in the case, as shown. On these terminal lugs external threads are cut from the terminal binding nuts right down to the bridges B. Level with the top of the bridges B slotted recesses C are moulded in the ends of the case. Two strips D of antimony, lead or other suitable material having a hole cast in one end of them, are passed over the threaded terminal lugs A and slid down till they rest on the bridges B. The holes in the strips D are sufficiently large to allow of the strips being slid laterally into or out of engagement with the slotted recesses C of the case,

N°199,785



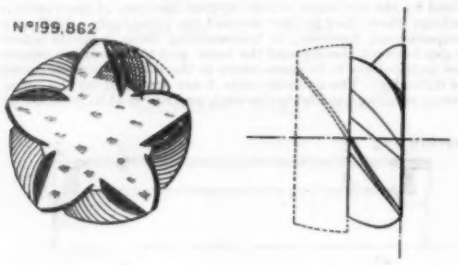
the holes in the strips being concentric with the terminal lugs A when in the engaged position with the slotted recesses C of the case. Two sleeved nuts E are screwed down the threaded terminal lugs A until they pass through the holes in the sliding strips D. The sliding strips D are thus locked into engagement with the slotted recesses C in the case, so that by further screwing down the sleeved nuts E pressure is put on the bridges B, thus pressing and locking both the positive and negative sections firmly down into the case. As a modification of the sleeve nut, plain sleeves F can be constructed as part of the lid.—*June 25th*, 1923.

MACHINE TOOLS AND SHOP APPLIANCES.

199,862. April 12th, 1922.—Gear Cutters, D. Brown and Sons (Huddersfield), Limited, Park Gear Works, Huddersfield, and F. E. Brown.

This cutter is designed to have imparted to it a continuous rotary motion combined with a slow linear or radial feeding motion in the same manner as the well-known hob form of cutter. The actual cutting edges are, however, in a plane at right angles to the axis of rotation, but the feeding motion is not parallel with this plane. The cutter comprises a core having a series of spirally arranged projections or teeth, of such shape that a section on a plane at right angles to the axis of the cutter produces the true shape of cutting edges desired. The true shapes of the teeth may be made to progress spirally around the cutter at any

N°199,862



rate, and clearance be obtained by using different rates of rotation for the two profiles of each tooth, and by gradually diminishing the height of the tooth, so that as the spiral progresses the section or size of the tooth becomes gradually smaller. All sharpening of the cutter is done in such a manner that the cutting edges always remain in a plane at right angles, or approximately at right angles, to the axis of the cutter; therefore the true shape can easily be produced, the cutter hardened and ground, and re-sharpened without altering the form, the only effect of re-sharpening being to produce a gradual reduction in the thickness of the cutting teeth as the cutting plane passes along the spiral.—*July 5th*, 1923.

MOTOR CARS AND ROAD TRAFFIC.

199,830.—March 31st, 1922.—Improvements relating to Electric Transmission for Vehicles, Tilling-Stevens Motors, Limited, and Harold Kenneth Whitehorn, of Victoria Works, Maidstone.

According to this invention, an auxiliary current generator or exciter A is driven at a speed dependent upon that of the road wheels, and is so connected as automatically to increase or decrease the voltage of the main generator B as the speed of the

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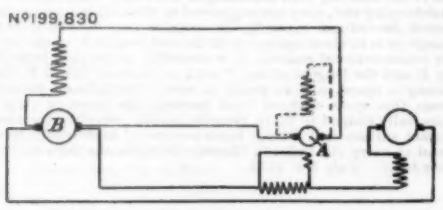
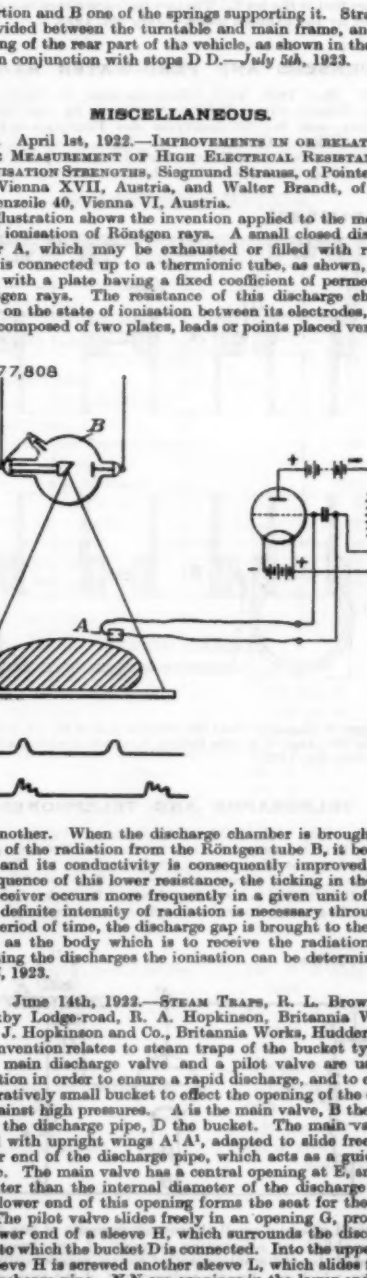


vehicle increases or decreases. Preferably, the auxiliary generator is in the form of an exciter in series with the field winding of the main generator. In this way, the heavy current required by the series-wound motor or motors, when starting or climbing or generally at slow speed or heavy duty, is automatically compensated by the drop in voltage and corresponding relief for the engine. The exciter may take the form of a separate machine, or, alternatively, may consist of a winding on the motor armature and a second commutator on that machine. The exciter field, when the exciter is a separate machine, may be separately excited by a battery or may be self-excited, or may be compound wound or have portions of its field windings otherwise differently excited. It may, further, carry a reversed winding of some few turns, which acts in opposition to the main winding, and is traversed by the current of the driving motor or a shunted portion of the current. In cases where there is series winding on the exciter fields, an adjustable divert may be provided in order to adjust the characteristic of the exciter to the varying characteristics of individual systems.—*July 2nd*, 1923.

199,890. May 9th, 1922.—Six-wheel Wagons, P. G. Hugh, 122, Eastern-esplanade, Southend-on-Sea, and G. Scammell and Nephew, Limited, Fashion-street, Spitalfields, London, E. 1.

The object of this invention is to prevent the rear part of a six-wheeled vehicle from overturning when it is turned more or less at right angles to the front part. A is the turntable for the

N°199,890



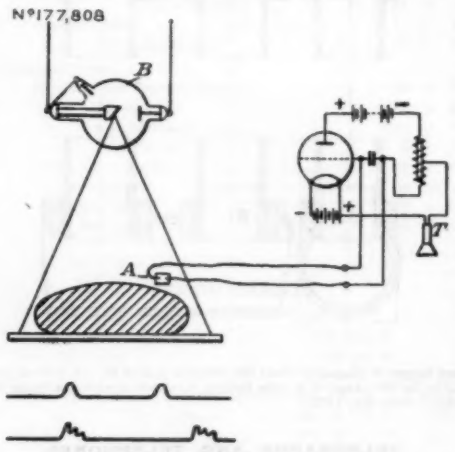
rear portion and B one of the springs supporting it. Straps C C are provided between the turntable and main frame, and limit the tilting of the rear part of the vehicle, as shown in the lower figure, in conjunction with stops D D.—*July 5th*, 1923.

MISCELLANEOUS.

177,808. April 1st, 1922.—Improvements in or relating to the Measurement of High Electrical Resistance of Ionisation Strengths, Siegmund Strauss, of Pointengasse 5, Vienna XVII, Austria, and Walter Brandt, of Linke Wienzeile 40, Vienna VI, Austria.

The illustration shows the invention applied to the measurement of ionisation of Röntgen rays. A small closed discharge chamber A, which may be exhausted or filled with rarefied helium, is connected up to a thermionic tube, as shown, and is covered with a plate having a fixed coefficient of permeability to Röntgen rays. The resistance of this discharge chamber depends on the state of ionisation between its electrodes, which may be composed of two plates, leads or points placed very near

N°177,808

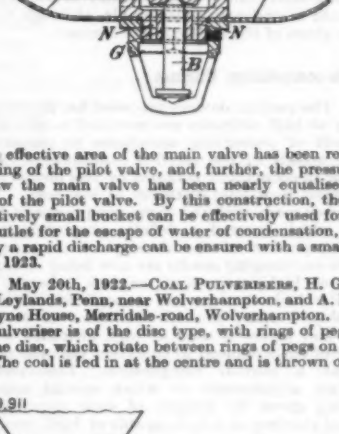


to one another. When the discharge chamber is brought into the path of the radiation from the Röntgen tube B, it becomes ionised, and its conductivity is consequently improved, and, in consequence of this lower resistance, the ticking in the telephone receiver occurs more frequently in a given unit of time. When a definite intensity of radiation is necessary throughout a fixed period of time, the discharge gap is brought to the same distance as the body which is to receive the radiation, and by counting the discharges the ionisation can be determined.—*July 2nd*, 1923.

199,936. June 14th, 1922.—Steam Traps, R. L. Brown, 35, Birkby Lodge-road, R. A. Hopkinson, Britannia Works, and J. Hopkinson and Co., Britannia Works, Huddersfield.

This invention relates to steam traps of the bucket type, in which a main discharge valve and a pilot valve are used in combination in order to ensure a rapid discharge, and to enable a comparatively small bucket to effect the opening of the outlet valve against high pressures. A is the main valve, B the pilot valve, C the discharge pipe, D the bucket. The main valve is provided with upright wings A^1 A^1, adapted to slide freely on the lower end of the discharge pipe, which acts as a guide for the valve. The main valve has a central opening at E, smaller in diameter than the internal diameter of the discharge pipe, and the lower end of this opening forms the seat for the pilot valve. The pilot valve slides freely in an opening G, provided at the lower end of a sleeve H, which surrounds the discharge pipe and to which the bucket D is connected. Into the upper end of the sleeve H is screwed another sleeve L, which slides freely on the discharge pipe. N N are openings in the lower end wall of the sleeve H for the admission of the water of condensation. The operation is as follows:—When the bucket descends on account of accumulation of water therein, the lower wall of the hollow shaft or sleeve H comes in contact with the head of the pilot valve and withdraws this valve from its seat, which it can readily do, since the valve seat has a small area. Then the further descent of the bucket brings the internal shoulder M of the sleeve L into contact with the upper end of the cage part of the main valve and forces the latter off its seat. This it can do,

N°199,936



since the effective area of the main valve has been reduced by the opening of the pilot valve, and, further, the pressure above and below the main valve has been nearly equalised by the opening of the pilot valve. By this construction, therefore, a comparatively small bucket can be effectively used for opening a large outlet for the escape of water of condensation, and consequently a rapid discharge can be ensured with a small trap.—*July 5th*, 1923.

199,911. May 20th, 1922.—Coal Pulverisers, H. G. Taylor, the Leylands, Penn, near Wolverhampton, and A. P. Smith, Aboyne House, Merridale-road, Wolverhampton.

This pulveriser is of the disc type, with rings of pegs on the face of the disc, which rotate between rings of pegs on the fixed cover. The coal is fed in at the centre and is thrown out at the

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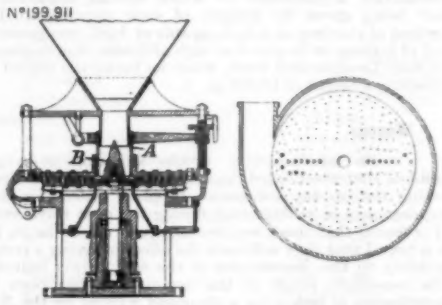

edge of the disc. The chief peculiarities of this mill are the form of the pegs, which are made triangular and can be turned so as to present the most advantageous angle, and the telescopic sleeve A. This sleeve can be adjusted for height and controls the feed of coal to the disc. The coal is given a preliminary grinding by the fluted cone B.—*July 5th*, 1923.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY, AUGUST 15TH.

Institution of Municipal and County Engineers.—Institution of Civil Engineers' Library, 35, Dawson-street, Dublin. Irish District meeting. 2.30 p.m.

FRIDAY, AUGUST 31ST, TO SATURDAY, SEPTEMBER 22ND.

Shipping and Engineering Exhibition at Olympia.

SATURDAY TO SATURDAY, SEPTEMBER 1ST TO 8TH.

Institution of Naval Architects.—Summer Meeting in Holland.

MONDAY TO THURSDAY, SEPTEMBER 10TH TO 13TH.

Institute of Metals.—Autumn Meeting at Manchester.

MONDAY, SEPTEMBER 17TH, TO WEDNESDAY, OCTOBER 3RD.

National Gas Exhibition at Bingley Hall, Birmingham.

CONTRACTS.

The Vickers-Spearing Boiler Company, Limited, of 20, Kingsway, W.C. 2, has received from the Birmingham Corporation an order for six water-tube boilers with superheaters, economisers, stokers and all accessories. The boilers are for a normal evaporation of 35,000 lb. per hour at 325 lb. steam pressure.

Meldrums, Limited, received during July orders for forced draught furnaces from three laundries, two collieries, a chemical manufacturer, a pottery, a potters' miller, a tar distillery, a timber works, a hospital, a fish curer, a foreign oil syndicate for burning shale, and a barracks; and for destructors from two engineers, two hospitals, one county council, and a hosiery manufacturer.